November 1960

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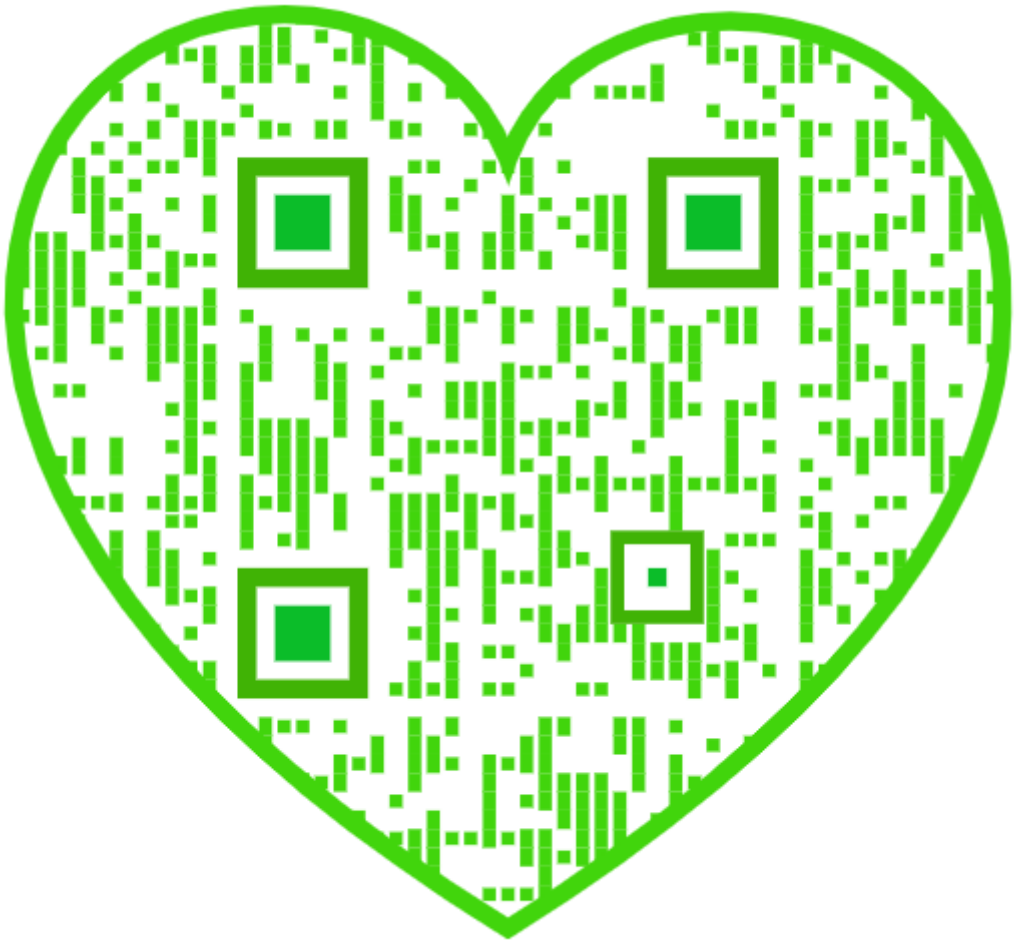
73

Amateur Radio



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November, 1960
Vol. 1, No. 2

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editor-publisher ..... Wayne Green W2NSD
publications manager ..... David Fish
associate editor ..... Jim Kyle K5JKX
associate editor ..... Don Smith W3UZN
associate editor ..... Marvin Lipton VE3DQX
contributing editor ..... John Campbell W2ZGU
subscriptions ..... Virginia K2MNW

The Cover: In the spotlight this month is the new 6DJ8/ECC88 tube by CBS Electronics, which, when applied to the front end of the Gonset Communicator (page 28), slashes the devil out of the signal-to-noise ratio.

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. . . de W2NSD

WELL, here we are with the second inaugural issue of 73. We're only one month old and you're already reading the magazine . . . amazing.

It is probably quite improper for me to take brand new subscribers to task and it may tend to create some apathy when I bring up the subject of your getting friends to subscribe, but still I am duty-bound (as head advertising salesman) to politely remind some readers that they did not send letters of encouragement to all of the advertisers in the first issue. Further, and with even more serious consequences, it seems that a few of the advertisers have not yet experienced the sudden upswing in sales that I may have led them to expect.

Fortunately, as you scan the advertising index of this issue, you will see that the hardier advertisers are willing to let bygones be bygones . . . providing that my over-optimistic promises for this month come closer to fruition. I realize that this is quite a lot of responsibility for you, but possibly you can chalk up the sudden expenses to Christmas or something. I'm sure that your tax consultant will agree with me that it is very poor planning to end up the year with extra money hanging around.

Now, about those subscriptions. Why not flip back to our subscription persuader and write in the names of several of your friends? This, with a small cash (or check) enclosure, will result in twelve equally spaced reminders of your kindness and generosity. We will also leave room for you to be generous to yourself, where it will certainly be most appreciated.

Feedback

We both have a vested interest in 73 being as interesting as possible. You can help me keep my finger on your pulse by sending a postcard every month listing the articles in the order of your interest. I will publish results of this monthly survey as an encouragement to the authors. The top author each month will get, in addition to the compliment, a check from us for 50% of his original payment. Thus your vote each month will serve to help me in the selection of future articles and will encourage good writers both with plaudits and some extra cash!
—W2NSD

Moonbounce Article

Among the items listed as tentative for our first issue of 73 was a feature article on the Moonbounce Project of W1FZJ. This, as you may possibly have noticed failed to come off as scheduled.

When I got word from Sam, W1FZJ, that the contact had finally been made I quickly drove up to his antenna farm just outside Boston and took some pictures of his latest antenna monstrosities. I figured that the event would be covered in the other ham magazines in September and that there was little point in rehashing it in 73 in October. After talking with Sam for awhile it was obvious that there were a lot of interesting things which had been overlooked by the previous interviewers. I suggested that he reduce these to written form to go with my pictures.

Thirty-two phone calls later, with the last minute deadline for issue #1 at hand, it became obvious that Sam wasn't going to be able to make it.

We've got some promises on other 1296 mc Mechanno that should be intriguing. Are you interested?

Cash

Everywhere I go people want to know what sort of articles we're looking for. My yardstick is simple: if the article is interesting and accurate I want to print it. I have found dozens and dozens of interesting pieces of equipment that should be written up. Haven't you designed something unusual which your friends have been asking about? Drop a card for our style sheet and get to it.

Your Money's Worth

An independent survey (by me) of the actual number of pages devoted to ham articles in the October issues of various ham publications was quite revealing.

73 Magazine	**46 pages**
Brand X	**37 pages**
Brand Y	**26 pages**

In looking over the feedback cards it is interesting to note that the John Campbell article, "How to be an Amateur", is, on most cards, either listed first or not listed at all. The obvious conclusion is that the prosaic title allowed many readers to miss this gem. By a strange and gratifying circumstance a feature article on John Campbell appeared in the October 8th issue of the Saturday Evening Post. The Post article was very interesting, and I suggest that you dig back and look it up. Ditto our article if you missed it. The final announcement of the feedback results of issue #1 will be made next month. If you haven't voted yet, hop to it.

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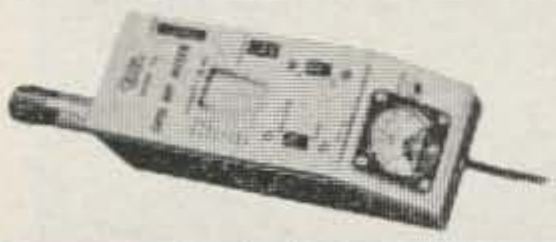

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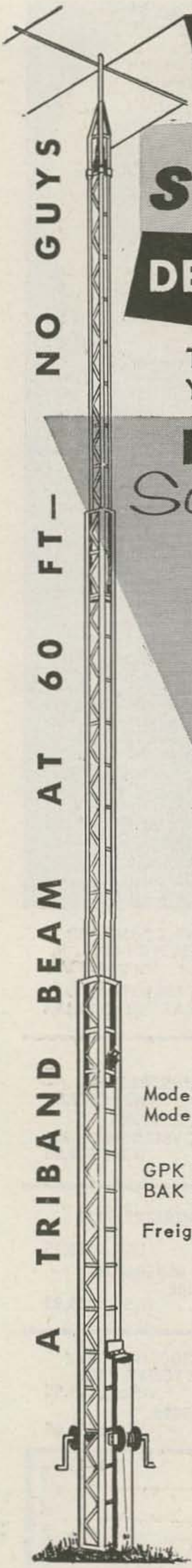

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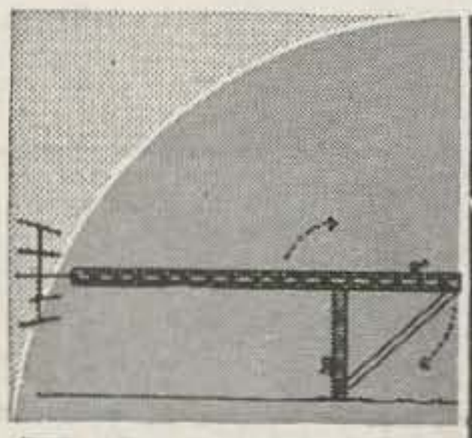

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A TRIBAND BEAM AT 60 FT — NO GUYS

Moon Trim

Sam Harris W1FZJ, chances debeardization at the business end of the Rube Goldberg contraption set up to cut the tape to open the Hudson Division Convention. I'm a little confused about the setup, but it went something like this: a signal was to be sent from W1FZJ on 1296 mc via the moon to W8LIO out in Dorset, Ohio. From there what was left of the impulse was to be sent to K2MGE out on Long Island. It was then to be relayed to a waiting receiver on top of the Statler-Hilton Hotel in Manhattan and down to the Convention Floor where it would be used to operate solenoid driven shears.

The shears were snapping angrily at anyone who dared to near them when I looked in on the setup the night before the Convention, being energized by random noises reaching the receiver. I missed the Big Event the next morning, but it obviously must have come off because eager amateurs began pouring into the exhibit area at 9 A.M. and queuing up for subscriptions to 73. Note "73" button on Sam.

Sam Harris, W1FZJ

6 10 15 20 meters

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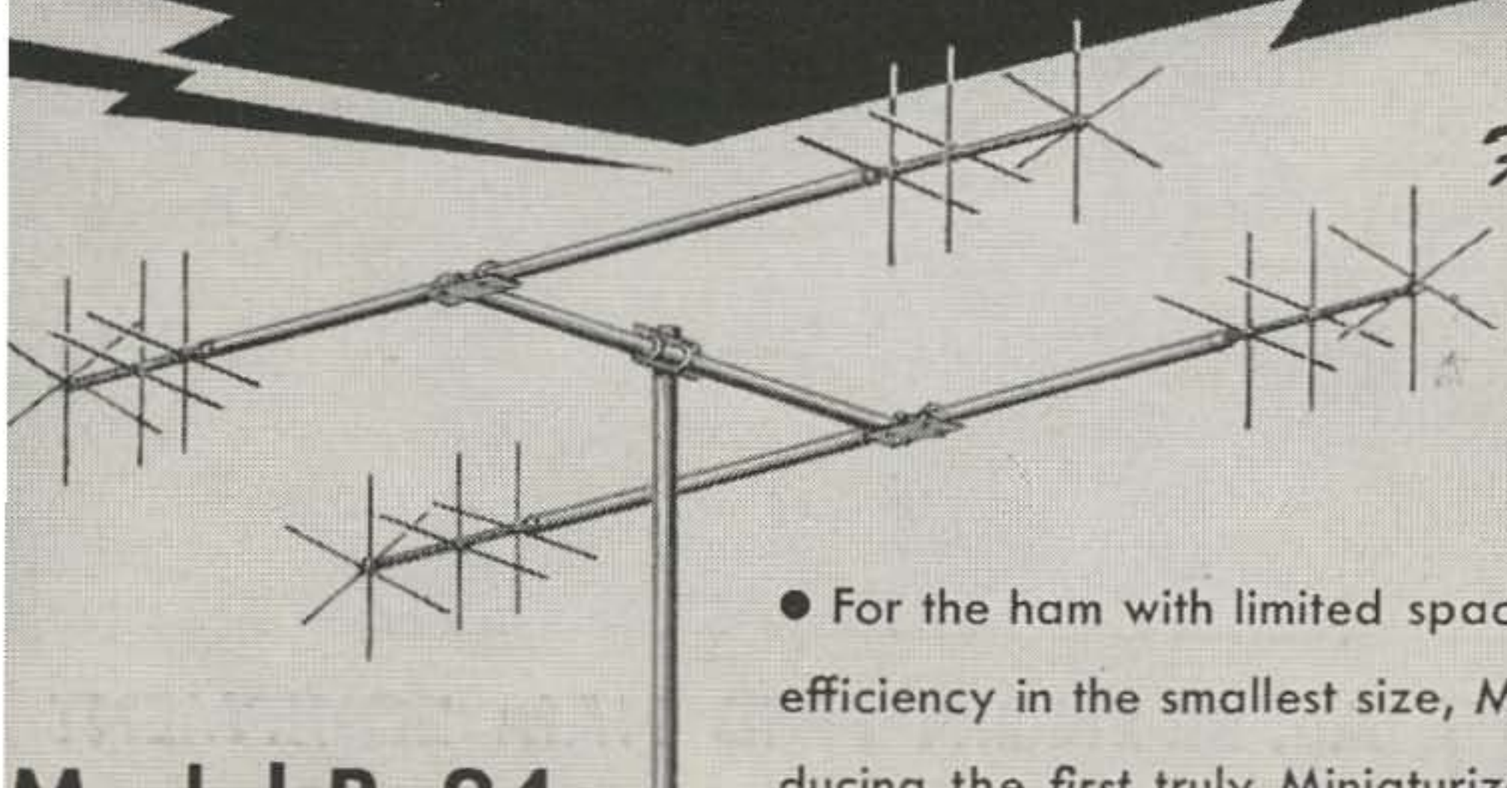

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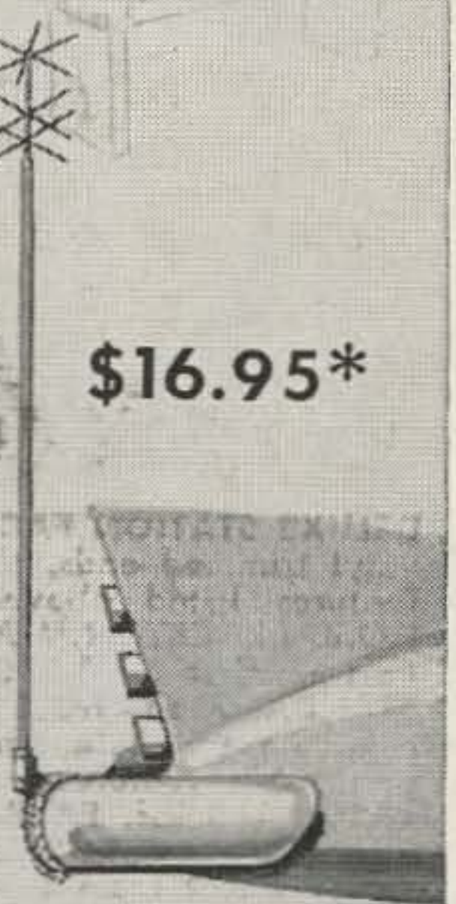

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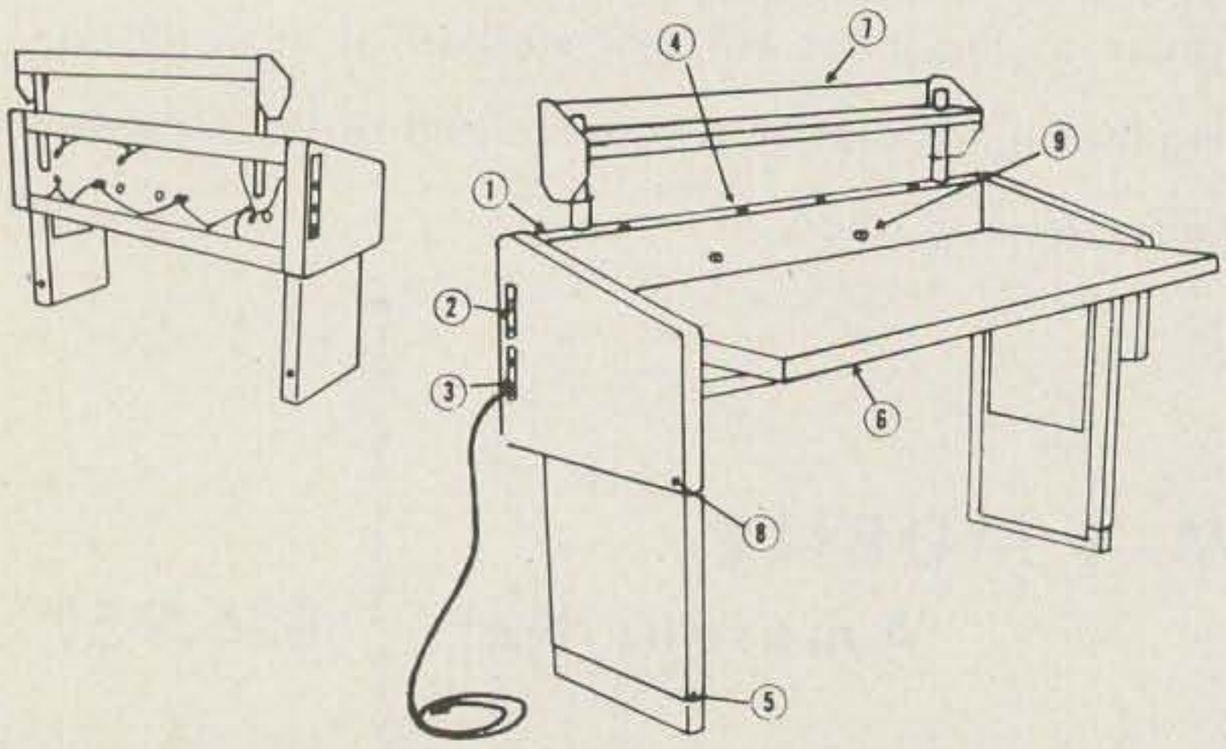

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9. DELUXE model equipped with 3 SO-239 RF an tenna lead connectors.
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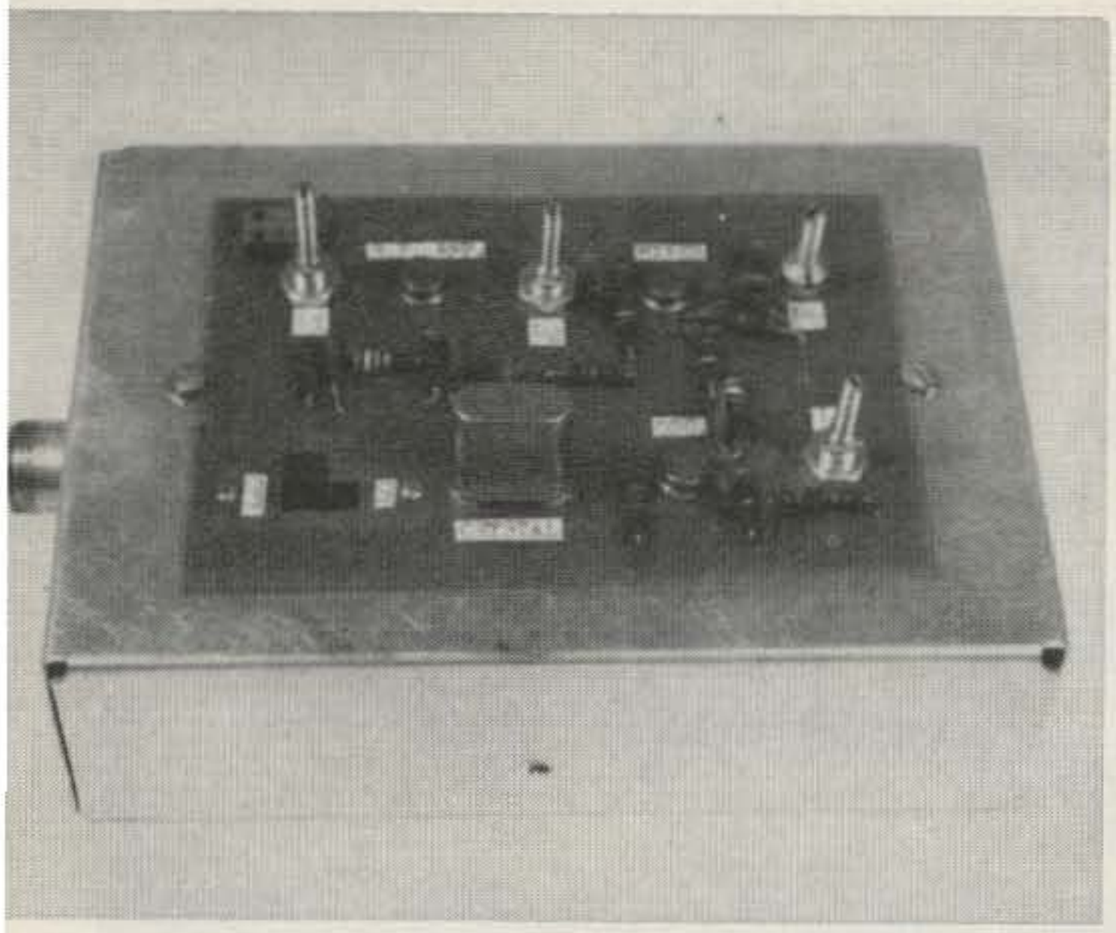

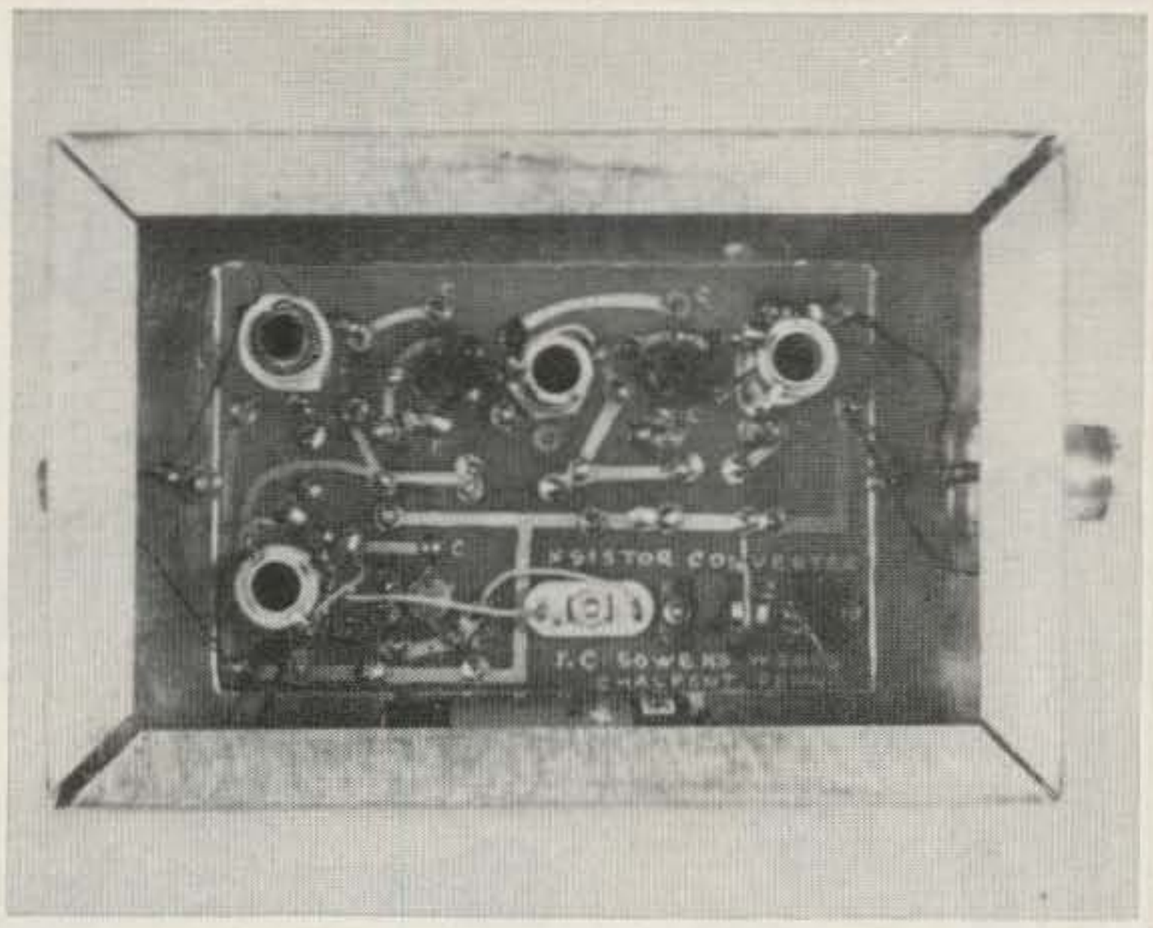

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Transistor Printed Circuit 10 Meter Converter

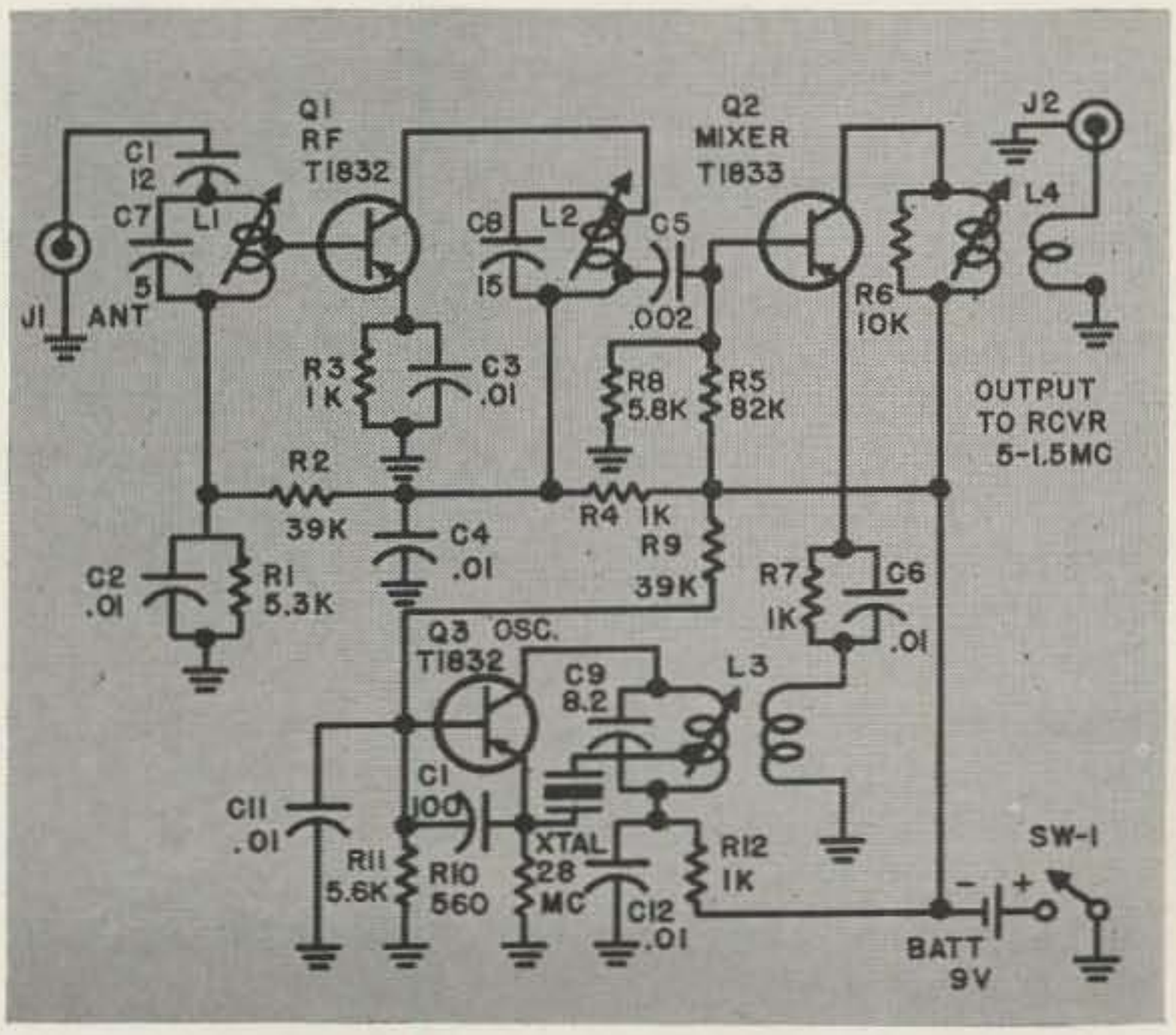
RADIO amateurs who have hesitated going mobile because of the necessity of making ıternal connections to the auto radio will find ıis x-sistor converter the answer to their long-waited dreams. It is also adaptable to the ıdio of the newer cars having the 12 volt bat-ry system. The only necessary connection to the auto radio is through the antenna, and this is simply a matter of plugging the antenna into the converter and running a short piece of coaxial cable to the antenna jack of the radio. The normal auto antenna may be used satisfactorily if it is extended to its full length, but a mobile whip of the proper length will

PARTS LIST

V-1—SPST Slide Switch
—Amphenol SO-239 coaxial connector
—(RCA Type) Phono Connector
ıtt. 9V Mallory No. TR-146R
ansistor Sockets (3) ELCO 3301
al—28 mc (overtone)

COIL DATA

—18 turns, #26 E. wire tapped at 3 turns from bottom end.
—18 turns, #26 E. wire tapped at 3 turns and 9 turns from bottom end.
—18 turns. #26 E. wire tapped at 3 turns from bottom end. The secondary is one turn of #26 E. wire over the primary with a piece of plastic tape between.
—Vari-Loopstick Lafayette MS-11 or equivalent. The secondary is 48 turns of #26 E. wire scramble wound over the primary with a piece of plastic tape between.
, L2 and L3 are wound on Cambridge Iron slug-tuned LS5 coil forms. Space wind the coils to cover one inch for wide tuning range.
Capacitors C7, C8 and C9 may have to be altered slightly for the 15 meter band.



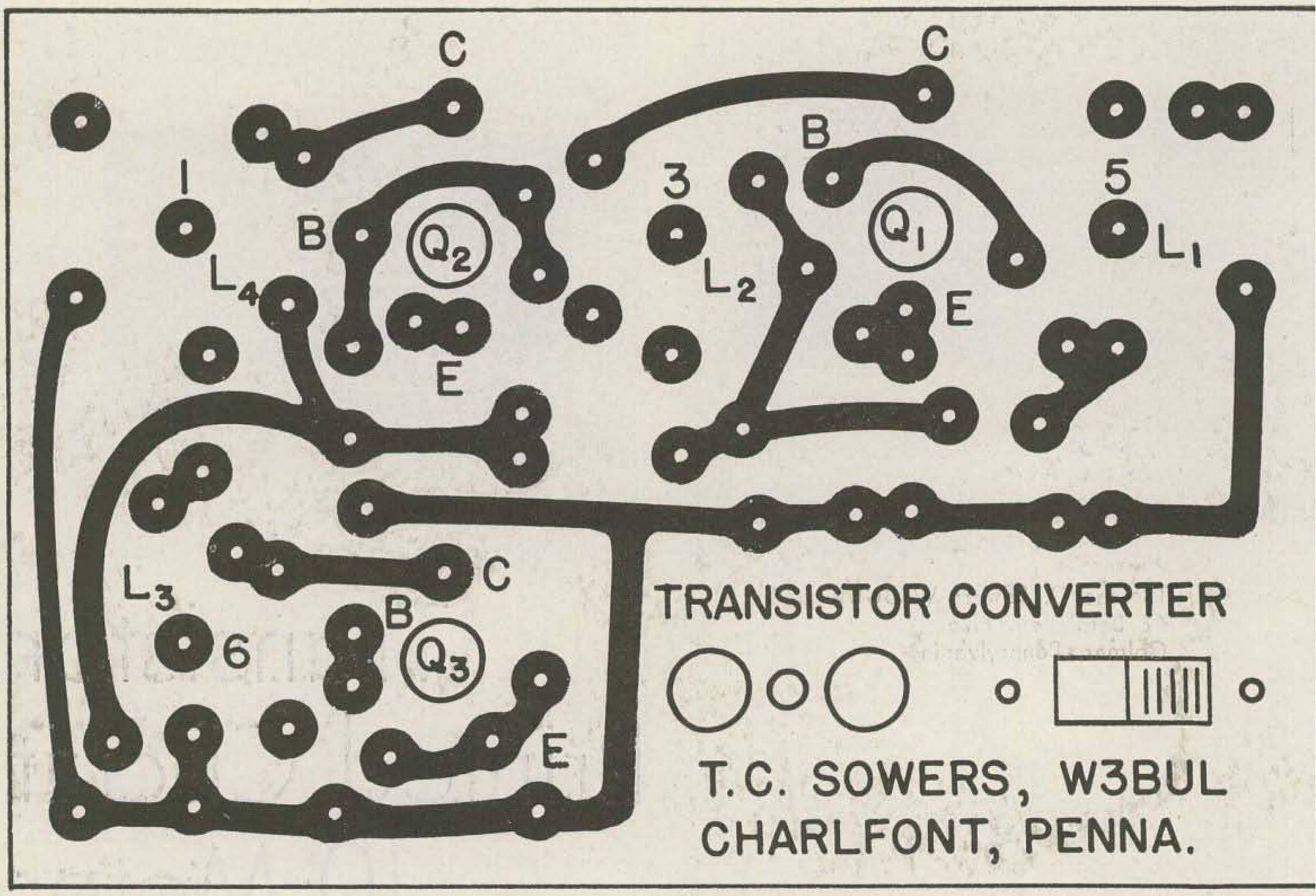


Fig. 2—Bottom View

give much better results and bring in the weak signals.

The early experiments were made using the PHILCO MADT 2N502A and 2N1158A Military type transistor. These transistors will oscillate well over 500 mc but prove to be too expensive for the average amateur and also are much more valuable for frequencies above the ten meter band. The availability of the PHILCO MADT T1832 and the T1833 at $2.93 at the time of this writing makes the x-sistor converter almost as inexpensive to construct as it would to construct a converter using the old fashioned, power consuming tubes which they replace.

The first model using the Military transistor was constructed on a brass chassis and was not crystal controlled. Transistors are sensitive to temperature changes and there was considerable chasing on the auto radio dial in order to keep a signal audible. The final design is a printed circuit board, a crystal controlled oscillator circuit and a self-contained power supply. The completed circuit board is mounted on a 6 x 4 x 2 inch Bud aluminum chassis. The power supply is a Mallory No. TR-146R mercury battery and is mounted under the chassis. The total current drain for the x-sistor converter is 2.5 to 3 ma so the battery should last for 3 or 4 months. The measured overall gain was 28 db at 29 mc with a loss of 2—3 db at 28.5 and 29.5 mc. The gain may be increased at either end of the band by peaking the coils at the desired section.

The writer has been using the x-sistor con verter for several months on ten meter mobil work with excellent results. A test has als been conducted side by side to a crystal con trolled and a well known commercial unit wit comparable results. Several amateur friend have constructed the converter and claim satis factory performance and feel that the con struction was a really worthwhile project.

The Circuit

If we follow the circuit diagram of the x sistor converter in Fig. 1 we see the antenn is capacity coupled to the antenna coil L through C1. The signal is then fed from th tap on L1 to the base of Q1 which is the r amplifier. This signal is then capacity couple to the base of transistor Q2 which is used a a mixer, and also to the base of transistor Q which is the oscillator. The signal from th collector Q3 appears across the primary c L3 and a portion of this is tapped off for feed back through the 28 mc crystal into the emitte The oscillator injection is link coupled to th emitter of the mixer Q2 from the single tur of wire over L3. The collector circuit of th mixer transistor is tuned by L4 to the *if* c the auto radio. Stabilization is provided in th emitter circuits with resistors R3, R7, and R1

The circuit board, being the platform c construction, must be made first. This is not a difficult as it may at first seem. With a litt

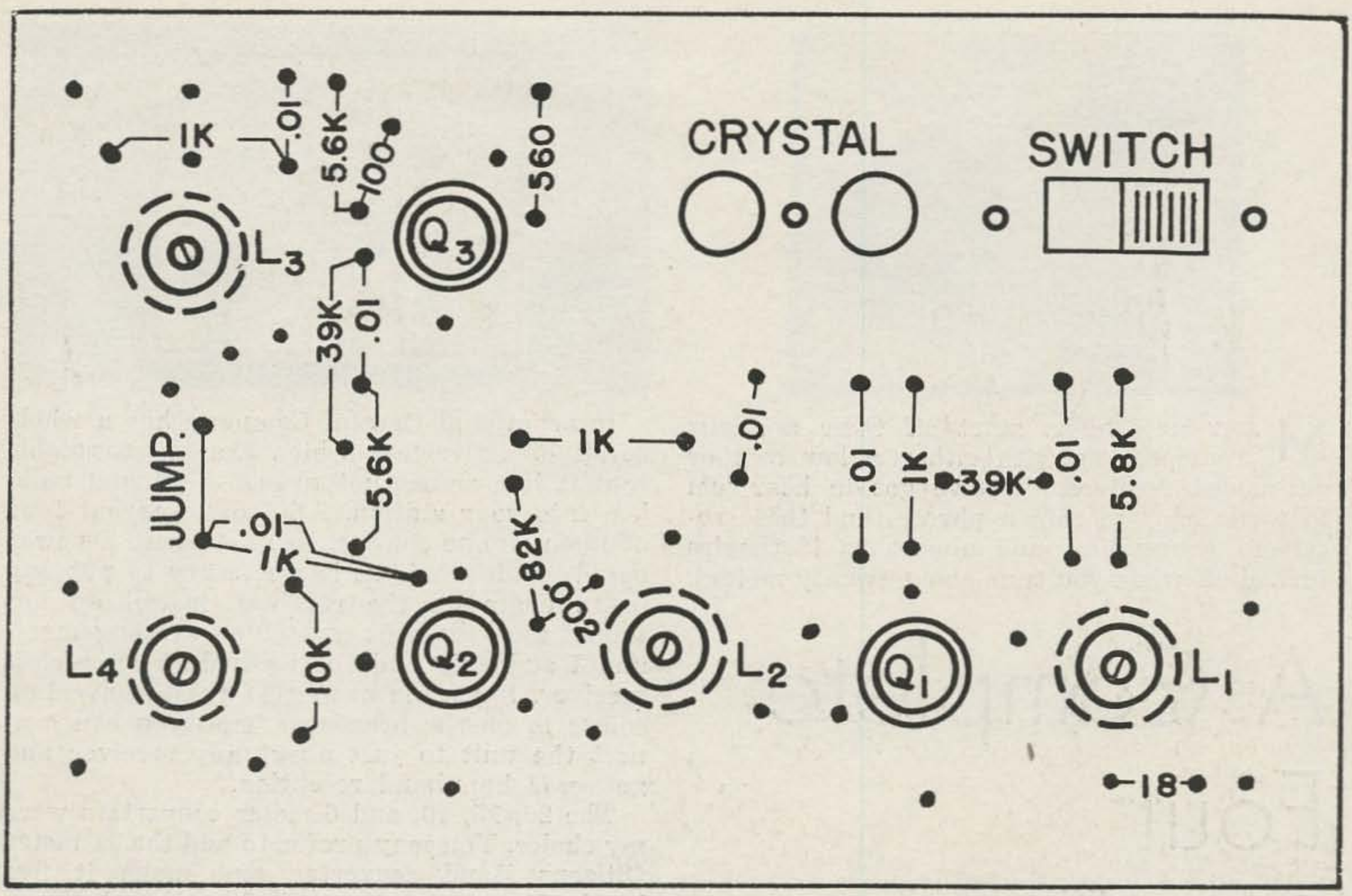


Fig. 3—Top View

patience and a couple of hours of effort a professional looking circuit board will be the reward.

Material List for Circuit Board

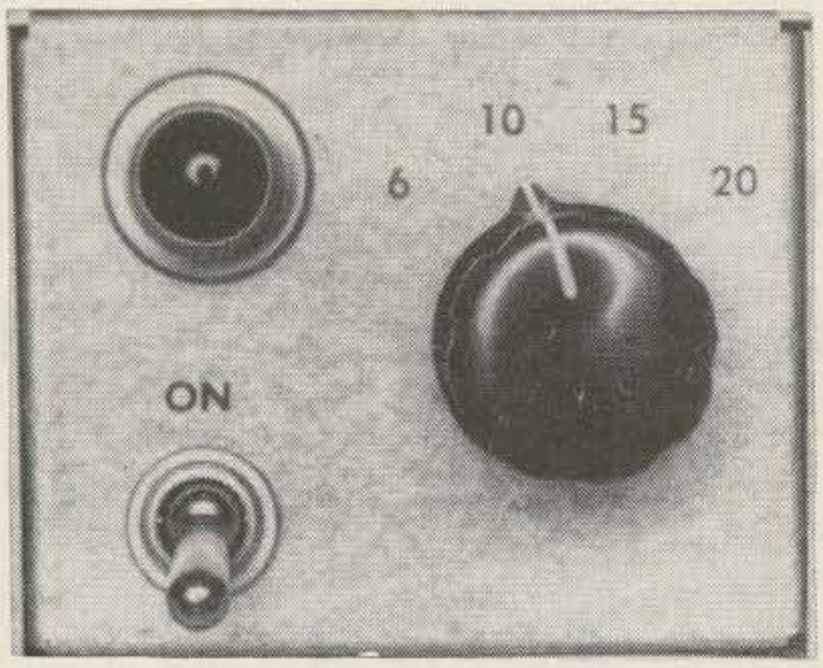
1. Copper clad laminate board 3 x 4½" (Lafayette Radio MS-512 or equivalent).
2. Tape resist circles $\frac{3}{16}$" diameter (Lafayette Radio MS-737 or equivalent).
3. Tape resist $\frac{1}{16}$ x 320" (Lafayette Radio MS-735 or equivalent).
4. Etchant 6 oz. (Lafayette Radio MS-729 or equivalent).

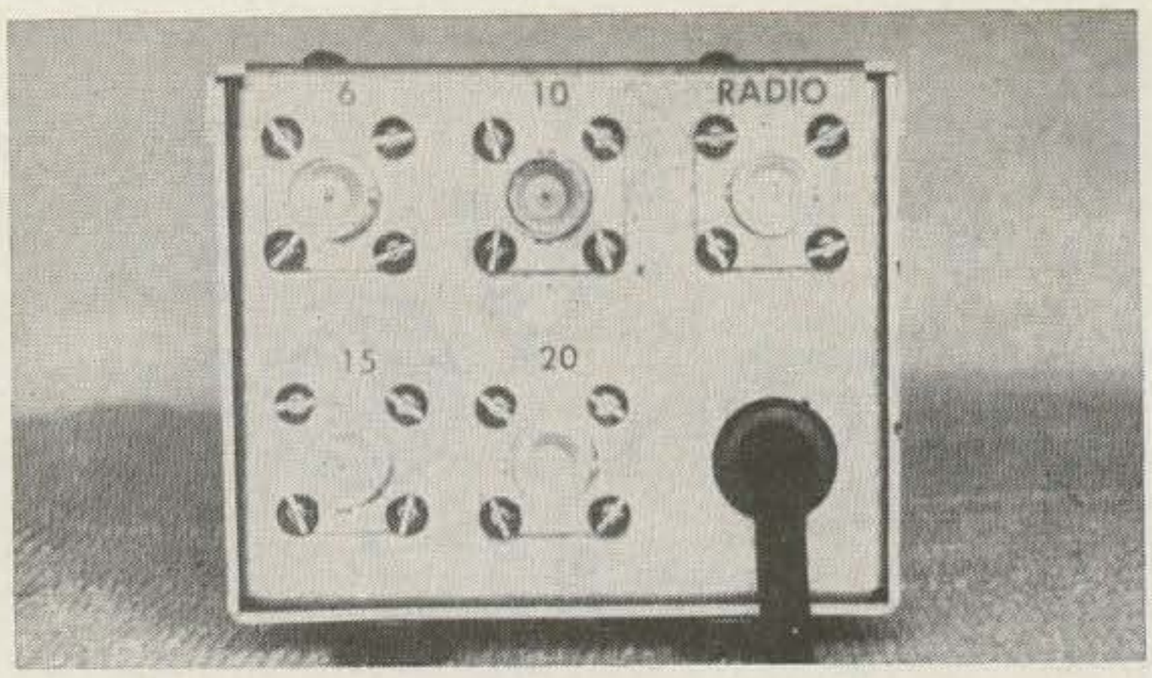
Start with the copper clad laminate circuit board material and layout as per Fig. 2. The simplest method is to take Fig. 2 and place it over the copper side of the board with a piece of carbon tracing paper between. Trace points one through seven for the coil forms and the transistor mounting holes, then continue tracing the circles and connecting bars throughout the entire circuit board. After tracing, it is a simple matter of applying the tape resist circles to the circles you have traced and apply the $\frac{1}{16}$" tape resist for the connecting bars. After the resist tape circles are applied remove the small centers which are punched through. By removing these centers, this will after etching, leave small centering points for drill spotting. Apply a tape resist circle to the board for spotting transistor and coilform mounting holes. . . .

Another method of constructing the circuit board is to lay out and drill holes for the coils and transistors and temporarily mount these parts. Following Fig. 2, apply tape resist circles and $\frac{1}{16}$" resist tape as nearly as possible to the drawing, being certain enough spacing is permitted for mounting resistors and capacitors as shown in Fig. 3.

After the resist tape is completely applied, roll it down tightly with a round bottle or jar and the board is ready for etching. Pour etchant solution into a glass dish or plate. The author used an old soup bowl which had a flat bottom. Immerse the circuit board into the solution with the copper up and agitate slowly. The board may be removed, rinsed in clear water and examined after about 10 minutes of etching. The process may have to be repeated several times, being careful not to over etch as this will tend to undercut the resist tape. The entire etching time should be 20 to 30 minutes in the solution. When all the excess copper has been dissolved rinse the board thoroughly with clear water. To eliminate any possible further chemical action wash the board in a solution of one tablespoonful of baking soda to one pint of water for 30 to 45 seconds. The resist tape may now be removed, and if the above instructions have been followed closely you should have a neat clean looking printed circuit board. The next step is to drill a $\frac{1}{16}$" hole through the center of each copper circle for mounting components and drilling holes for the coils and transistors. When drilling holes for

(Continued on page 59)





MANY new hams start off their amateur radio career with either a low cost or out-moded receiver. "You've got to hear 'em to work 'em," to coin a phrase, and these receivers generally sound almost as if they're turned off when you tune above twenty meters.

A Complete Four Band Crystal Converter

Donald A. Smith, W3UZN
Associate Editor.

One of the simplest solutions to this problem, other than shoveling the cabinet of the old receiver full of dollar bills and heading for the nearest dealer for a trade on a new Super Band-Banger DeLuxe, is to put some "hot" converters in front of the old relic and then stand back.

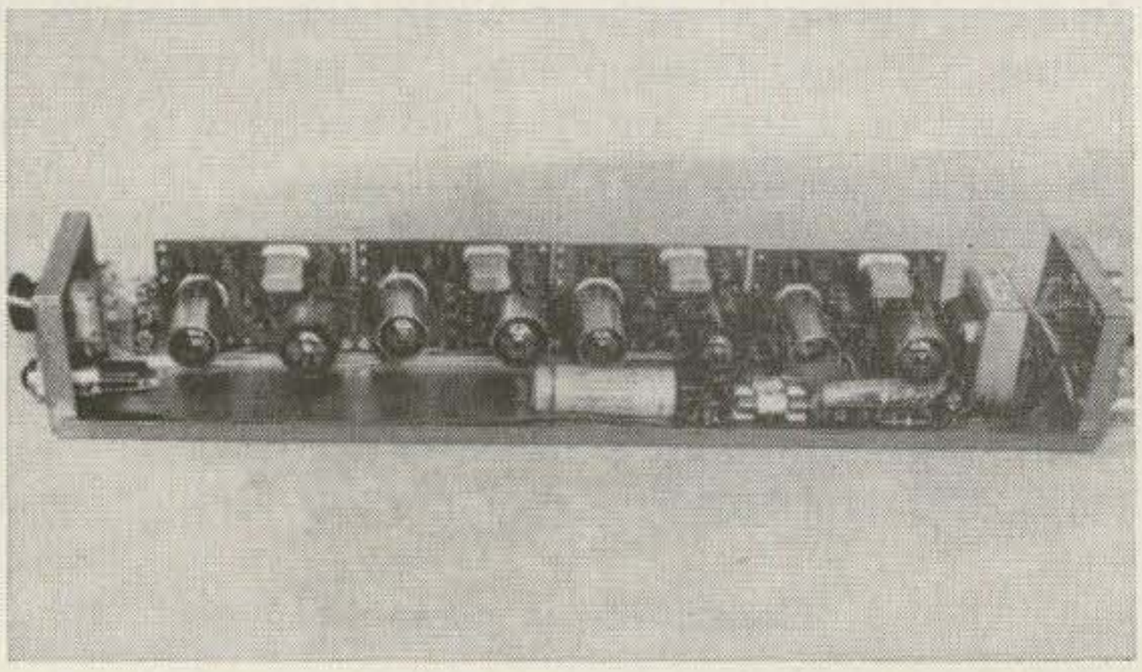
International Crystal Company has a whole series of converters which are so reasonable that it is a shame not to buy a set and build 'em into your station. All I did was put four of them on one chassis, complete with a power supply so it wouldn't be necessary to put any extra drain on the receiver, install an antenna and filament switching arrangement, and I suddenly had the equivalent of a good receiver. Since the output of these converters comes in on the broadcast band you can connect the unit to just about any receiver and get good ham-band reception.

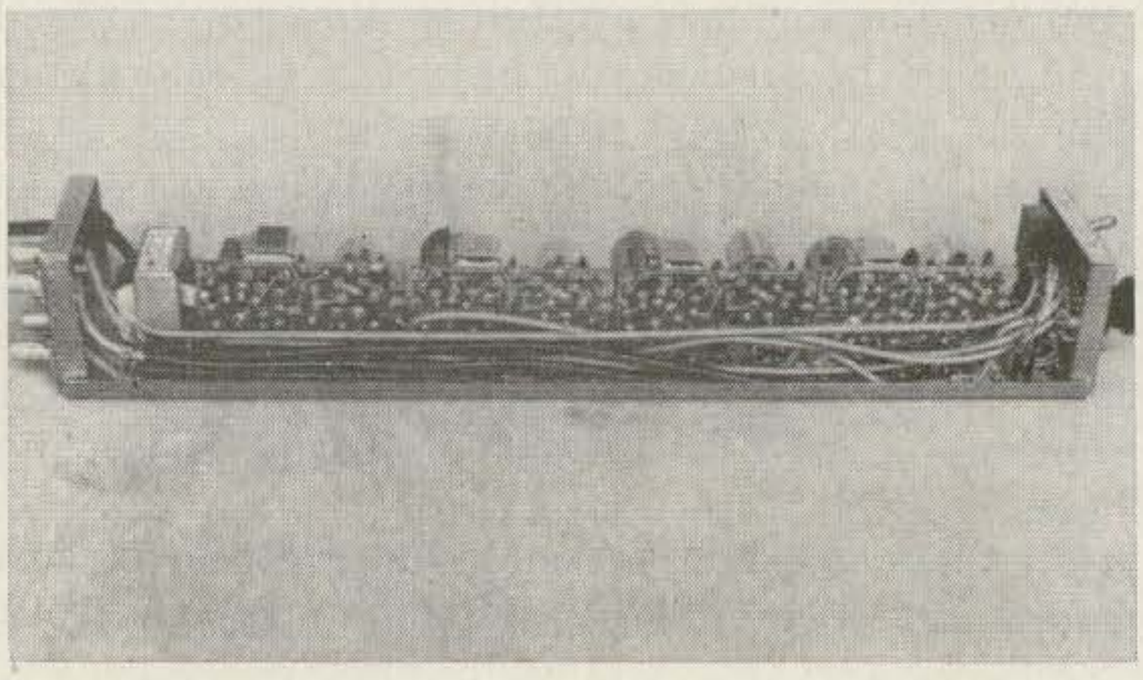
The 20, 15, 10, and 6 meter converters were my choice. You may prefer to add the 11 meter Citizens Band converter and make it five bands. Permission granted. Be sure, when you order your converters, to specify the BC if of 600-1600 kc.

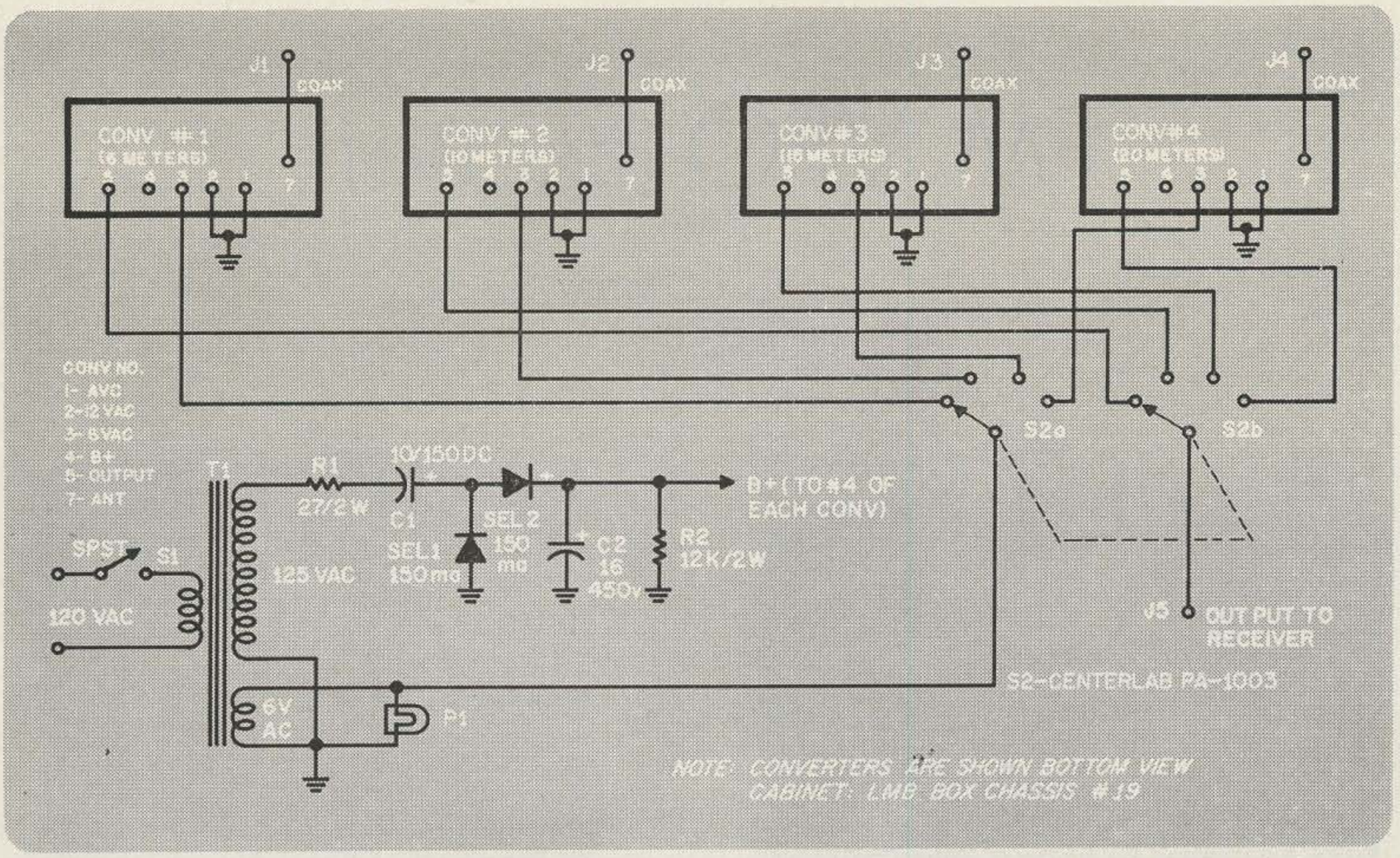
The only connection between this unit and your receiver is the antenna. This means that you can use this with any of the ac/dc receivers such as the National SW-54 and the Hallicrafters S-38. Sensitivity should run better than 1 microvolt, which is darned good.

Construction

A long slender case is used to house the converters and power supply. This may appear unusual, but it is less demanding on desk space. It may be placed next to the receiver, bolted under the desk, or in any other convenient spot. The converters are mounted on their sides by means of small right angle brackets. They come with holes in each corner, so the printed circuit boards do not have to be drilled. The converters are mounted with the crystals up and the terminals down close to the chassis.





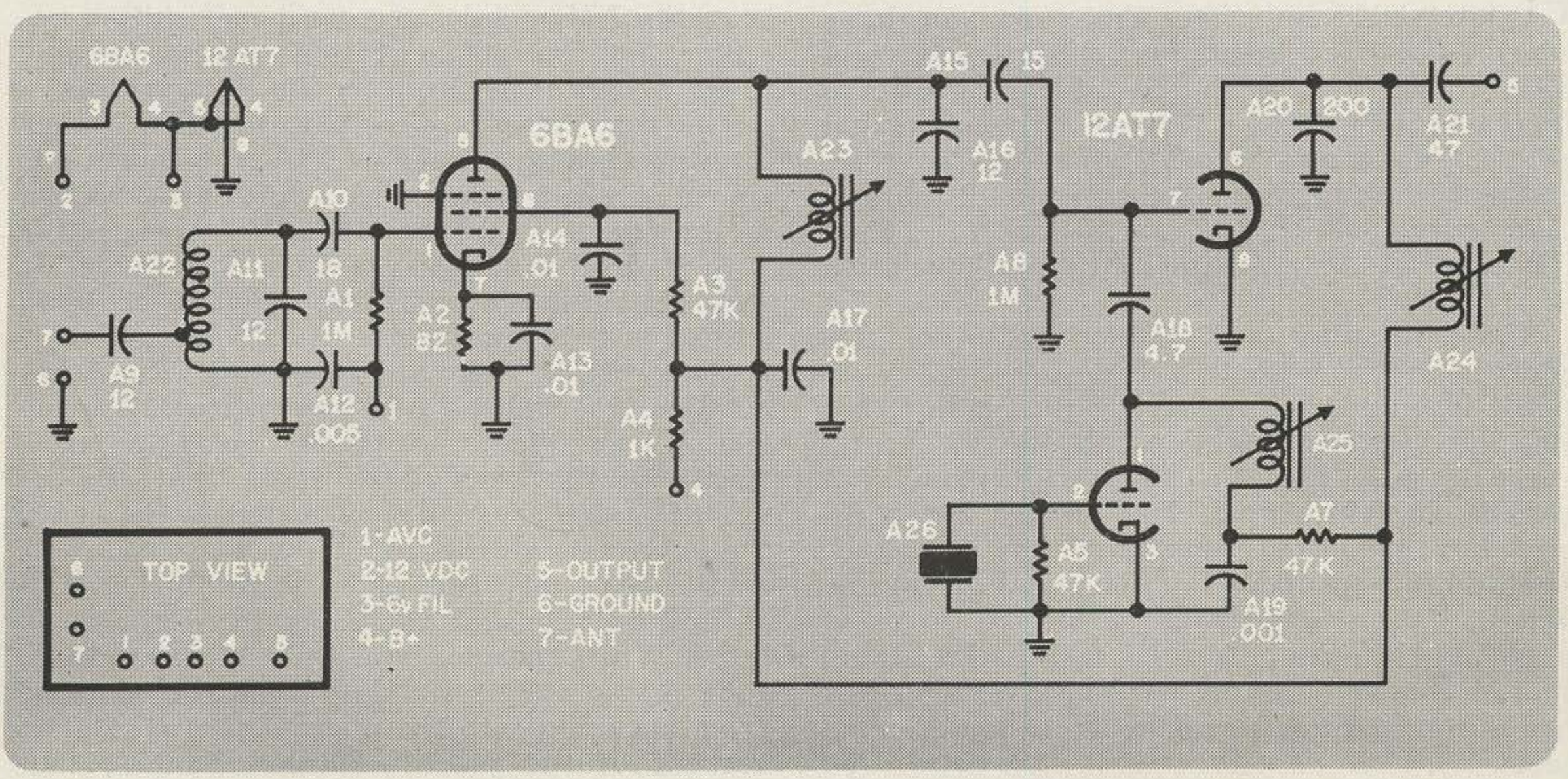


Study the photographs for the layout of the other parts, such as the power transformer, silicon rectifiers, filters, etc. The antenna jacks (BNC connectors), are mounted on the back of the chassis, and the off-on switch, selector, switch and pilot lamp on the front. Note that small coax cable is used to connect each antenna connector to its converter. Regular insulated shielded cable (small) is used to connect the output of each converter to the selector switch as the losses at BC frequencies are not high and the shielded cable works fine. B+ voltage from the supply is connected to the B+ connection of each converter and the filament voltage is switch by the band selector, S2.

Adjustment and Operation

The converters are aligned by the manufacturer, but with 6 meters, where only a portion of the band is generally used, an increase in performance can be had by peaking the three coil slugs in the middle of the band you will be using.

Performance was increased by 12 db on ten meters when the unit was used with an S-40B. Quite a difference! The unit is easy to construct and should give the Novice or Technician no problems. If you want a four band converter you will have to build it, since it can not be purchased. 73



FM VFO Exciter

D. L. Cabaniss, WITUW
165 Matthews St.
Bristol, Conn.

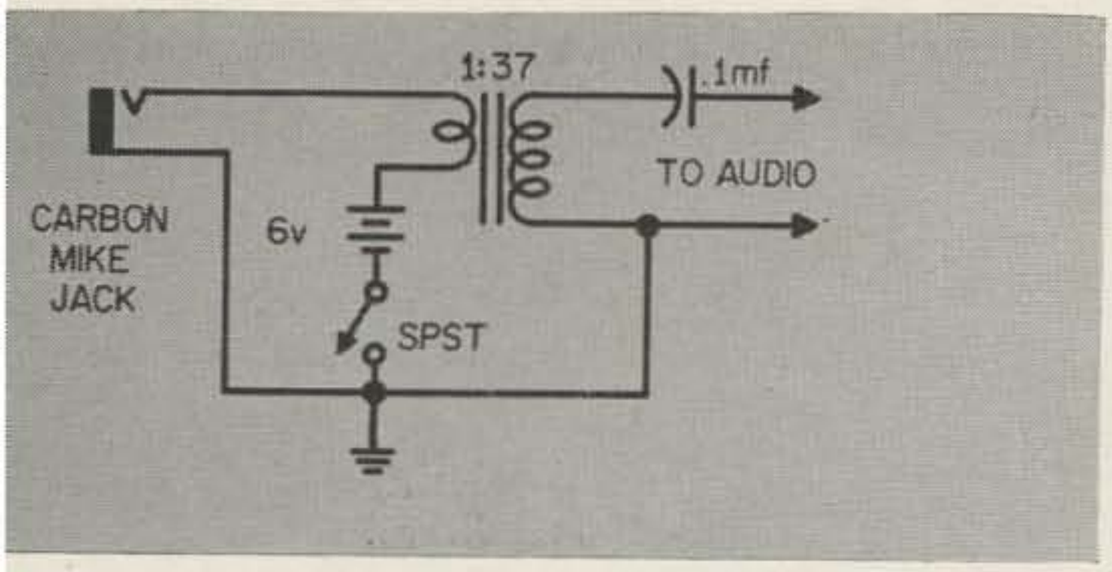
HAVE you been listening on 10, 6, or 2 meters lately? If so, then I'm sure you have heard quite a few amateurs using narrow (and wide) band FM. With the advent of all the surplus commercial FM gear now appearing on the ham market, many amateurs have installed these single and multi-channel units in their automobiles. The advantages of mobile FM cannot be appreciated until you have tried it!

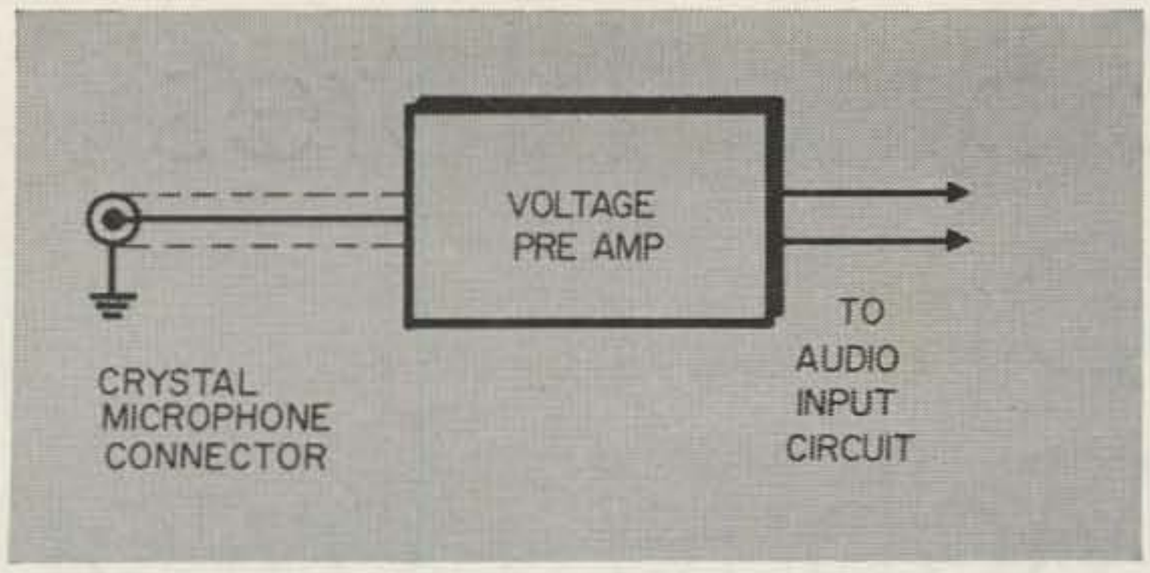
Those familiar with the operation of FM equipment know that a FM signal may be tuned in on a AM receiver by tuning to either side band (slope detection). However, the reverse is not true. An FM receiver will not receive an AM signal. FM receivers are designed to purposely "wash out" any amplitude variations appearing on the received carrier, whether these variations be in the form of noise or AM modulation. IF and limiter stages in FM receivers run at low plate voltages and are designed to saturate above a small signal level.

All this boils down to one fact; you can hear the FM mobile on your home station receiver, but the mobile station will not be able to copy your AM signal on his FM receiver.

The best way to solve this problem (other than purchasing a surplus FM transmitter) is shown in the photograph; a cut-down version of the 40 meter ARC-5 (BC-459) transmitter with a built-in reactance tube modulator. It took the author about three evenings to build it up and it performs like a million bucks.

However, to modulate *this* VFO with a reactance tube proved to be somewhat of a problem. Those familiar with the operation of a reactance tube modulator know that the reactance tube is usually connected to the tuned plate circuit of the oscillator and the plate of the reactance tube is usually at the same rf and dc potential as the plate of the oscillator. When the grid voltage of the reactance tube changes (this change in voltage resulting from speaking into the microphone), the plate current of the reactance tube changes, thus





anging the current through the tuned plate rcuit of the oscillator and shifting the os- llator frequency. However, the oscillator plate rcuit of the ARC-5 transmitter is at rf ground otential through a .05 mfd capacitor (refer the circuit diagram). After considerable ex- rimenting, I wound up with a modified re- tance tube circuit connected to the oscillator id circuit.

The maximum fundamental frequency shift my particular unit is approximately ± 1 . Feeding this unit into the crystal socket my Apache, and multiplying up to 10 meters ves a carrier swing of ± 4 kc (8 kc band- dth). Above 29.000 mc, wide band FM is rmitted, so the deviation control may be n full open. However, below 29.000 mc, BFM must be used so the deviation control ould be cut back to produce a fundamental cillator swing of .750 kc. This produces a rrier swing of ± 3 kc (6 kc bandwidth) on n meters. If the exciter is used in the 8 to mc region for multiplication up to 6 meters, termine the carrier swing by multiplying e oscillator swing X 6. If the unit is used 2 meters, multiply the oscillator swing X (in the 9 mc region) to determine the car- er swing at 144 mc. (My particular unit has en used on 10 meters only, but if sufficient ages of multiplication are available, the unit ould perform very well on both 6 and 2 meters). The deviation control therefore has a different setting for each band of operation. The ARRL Handbook contains excellent information pertaining to the calibration of FM exciters. It is suggested that the builder consult the Handbook and determine the oscillator swing before using the unit on the air.

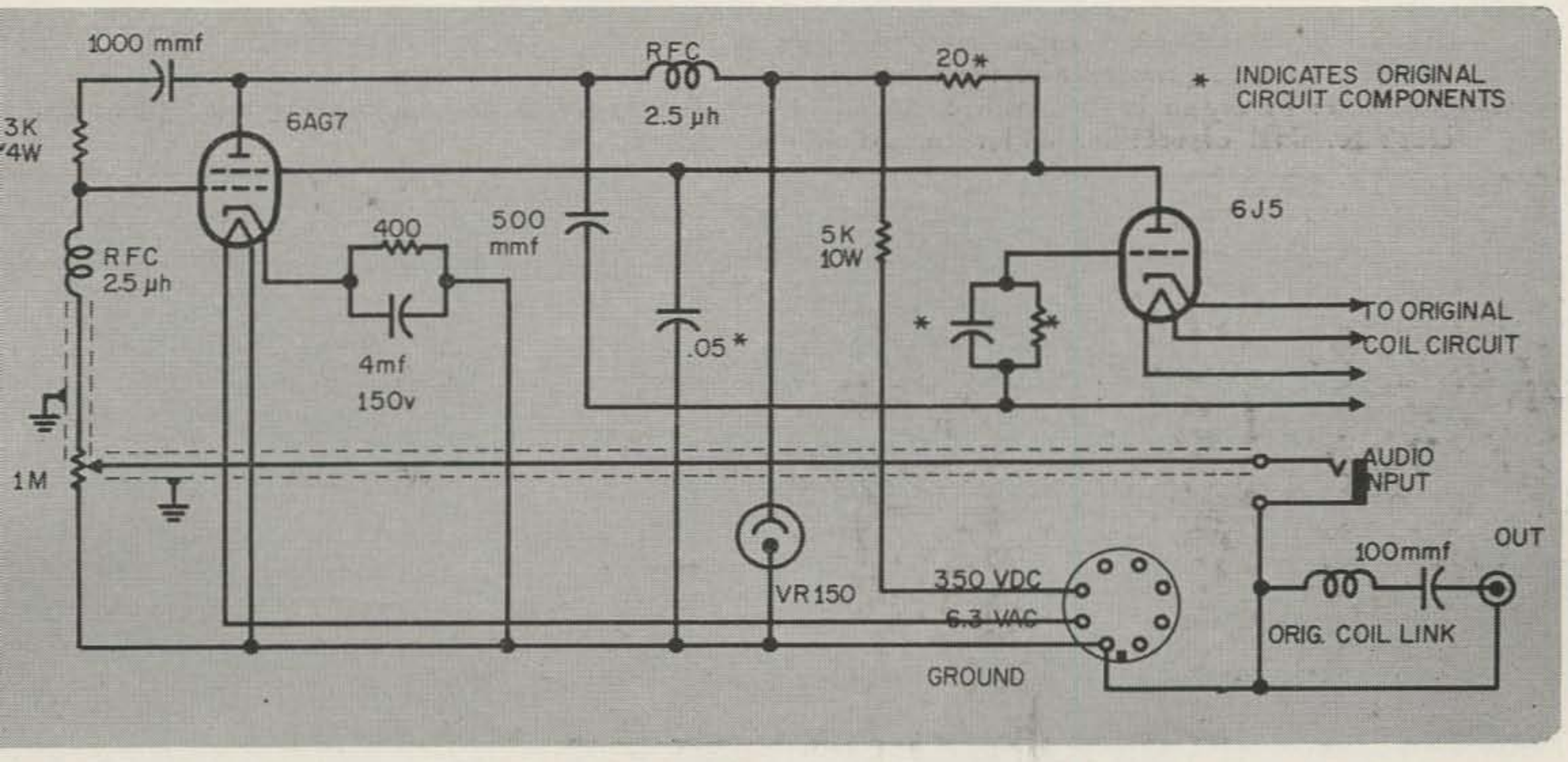
Construction

You can build this FM-VFO without hacking up the BC-459, but it does make a neater unit if you do chop it in half. If you follow my lead you will use the variable condenser which is attached to the front panel to tune the VFO and take out the other one plus the fixed condenser. Remove almost all of the wiring, leaving only those wires coming from the VFO coil unit. It is a good idea to replace the power socket with a regular octal tube socket.

Replace the 12 volt 1626 oscillator with a 6J5. Wire in the 6AG7 reactance tube in the center socket and the VR tube in the remaining socket.

The photos show almost everything else. You can put tape behind unused holes, putty them in with metal putty, sand and paint.

The reports I have received with this exciter driving my Apache have been very good and the FM mobiles have stopped calling QRZ? 7 3



Some Notes On Mobile Power

Jim Kyle, K5JKX/6
Asssociate Editor 73

FOR MANY persons, the problem of power for a mobile rig was solved a couple of years ago with the introduction of the transistorized dc-dc converter and its amazing efficiency.

For others, however, the transistorized power supply didn't prove to be the solution to the problem. This is the story of another high-efficiency answer to the ever-present problem of the mobile ham—power.

Though the transistorized supply is admittedly vastly superior to the older high-voltage sources in both utilization of battery power and in ease of operation, it does not permit an appreciable increase in transmitter power.

Yes, with a good transistorized unit you can run a 100-watt mobile while dynamotors restricted you to 50 watts and vibrapacks were doing well to power a 10-watt peanut whistle. But the difference between 100 watts and 50 watts is only 3 decibels, and that's less than half an S-unit.

Taking into consideration the relatively inefficient antennas usually available for a mobile rig and the poor location conditions usually encountered, it's not hard to see that a mobile unit must have high power to be certain of contacts.

If your only interest is gabbing with the gang on your way to and from work each day, this business of "certain contacts" may not be important to you. However, if you ever plan to use your mobile gear in civil defense or disaster work, the more power the better. And no one likes to be drowned out by a 100-watt home station.

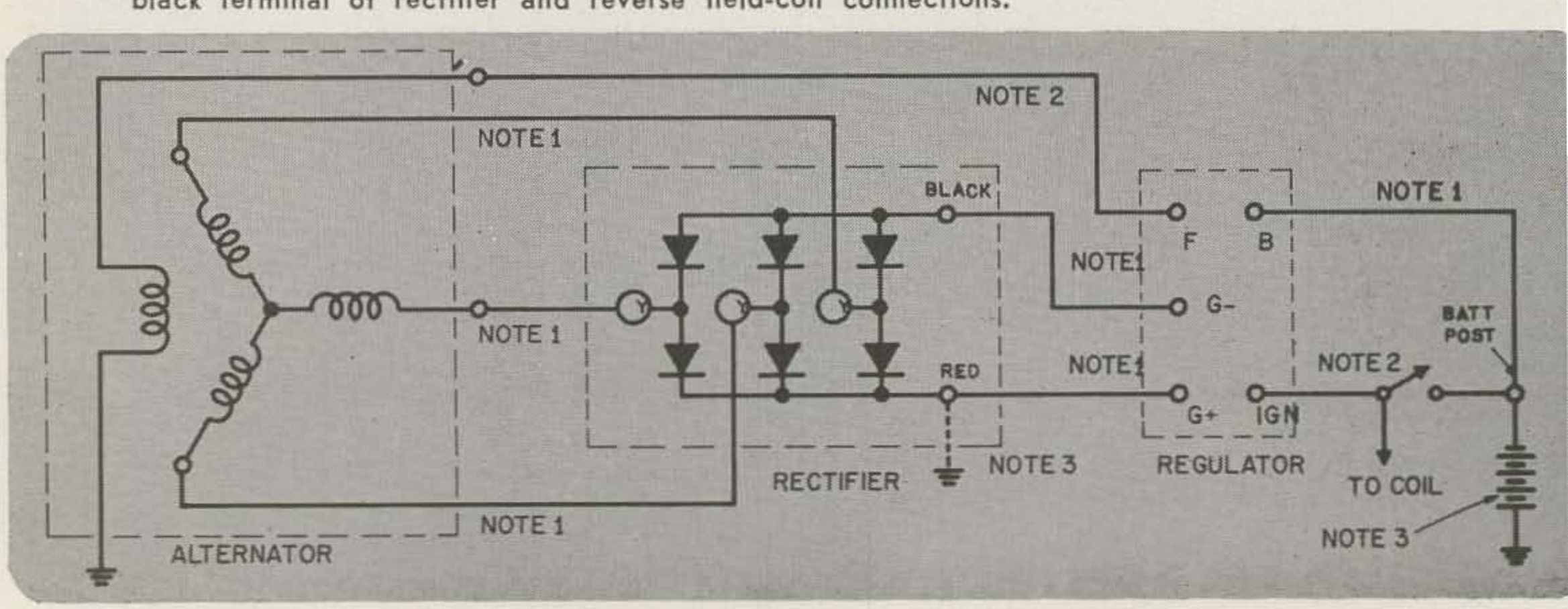
The limiting factor which keeps most mobile installations below the 100-watt power level is the car's own power system. Almost no standard generator will deliver more than 500 watts—and this can only be attained at speeds above those considered safe in urban traffic.

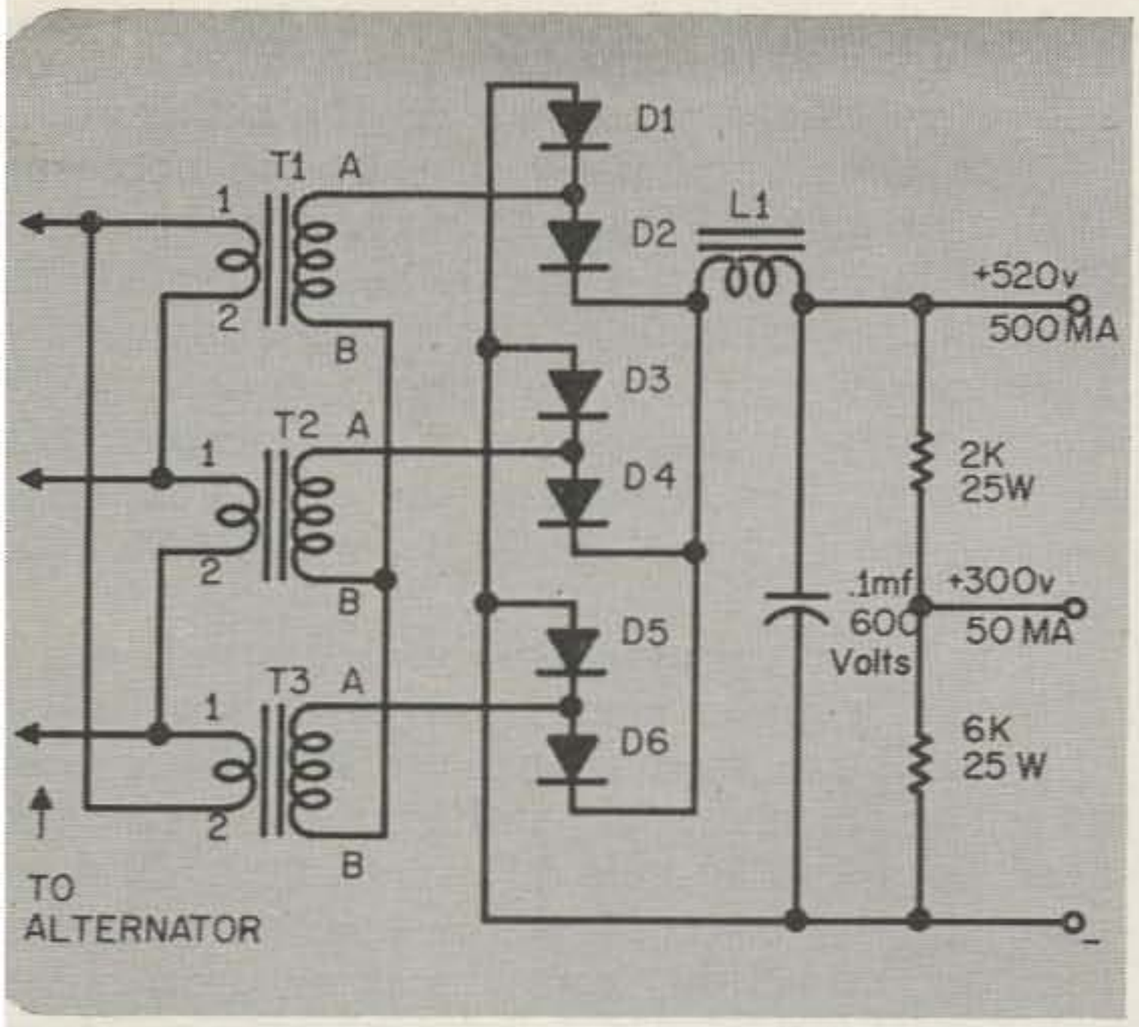
Of this maximum 500-watt capability, more than 100 watts are normally consumed by the auto ignition and instrument system. Another 150 watts or so go into the lights during night driving. This leaves only some 250 watts available for powering any accessories, keeping the battery charged, and running a ham station—and this is all calculated on the basis of 60 to 70-mph speeds. At 35 mph, there's almost nothing left over.

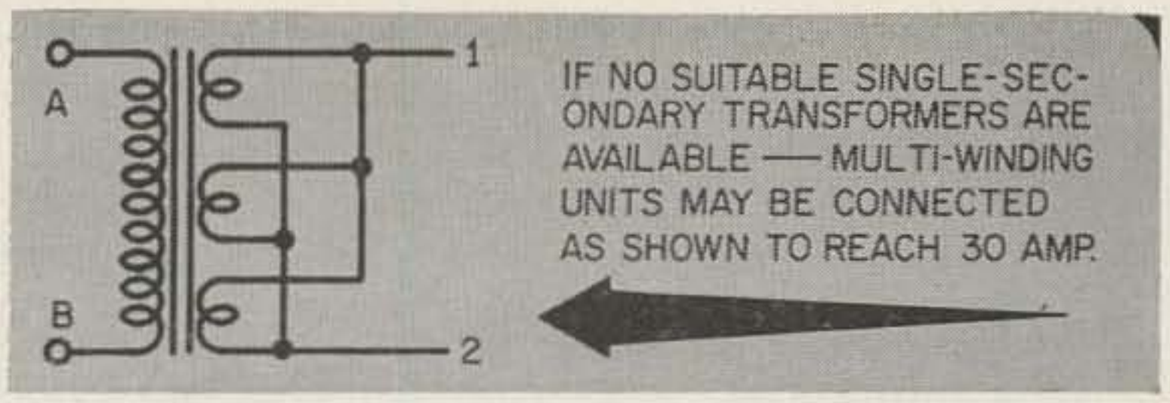
At traffic speeds, you can see, the mobile ham station must draw all its power from the battery. The battery will normally deliver about 200 watts for one hour before giving up and quitting. Most mobile operators have already learned this, and carry a pair of heavy jumper cables with alligator clips to steal power from

Fig. 1—Schematic Diagram, Alternator Installation

NOTES:
1—Use No. 0 electric-welder cable for these leads.
2—Use No. 14 auto primary wire for these leads.
3—Schematic as drawn is for positive-ground system. For negative ground, move ground point to black terminal of rectifier and reverse field-coil connections.






A
B
1
2
IF NO SUITABLE SINGLE-SECONDARY TRANSFORMERS ARE AVAILABLE — MULTI-WINDING UNITS MAY BE CONNECTED AS SHOWN TO REACH 30 AMP.

PARTS IDENTIFICATION:

T1, T2, T3—Surplus 400-cycle fil. XFMR, 120-volt pri., 6.3-volt sec., 30-amp sec. rating. Connect backward.

D1 thru D6—Silicon diodes, 600-volt PIV, 500 ma. Mallory 1N 2093 units may be connected in series to reach this rating, as can Audio Devices 30-B5 units.

L1—1 henry choke (Merit C-2996 or equivalent).

Fig. 2—Schematic diagram, 3-phase delta-wye full-wave power supply for use with mobile alternator system.

nother car's battery after an extended session on the air.

These facts may seem to limit all mobile quipment to the low-power classification. Iowever, there's a way around them—and hat's the thing this article is all about.

The power limit imposed by the car's elecrical system is traceable directly to the genrator. Shunt-wound dc generators are noorious for poor current regulation with varyng speed, and any dc generator is limited in urrent capacity by the brushes and comnutator.

Neither of these difficulties are present in an c system. For many years, alternating-current ystems for automobiles have been available. Ianufacturers include Delco-Remy Division f General Motors, and the Leece-Neville Co.

Using an alternator in place of the genrator, the car's power system has a 300-watt apability with the engine idling, and this gure rises to 700 watts at a speed of 20 mph. t's no wonder that police and emergency ehicles have long used alternators for power.

The main drawback to an alternator sysem has been the cost. The current price of a eece-Neville 700-watt 12-volt unit, with do--yourself installation, is slightly over $250. he Delco unit is slightly more expensive.

However, these prices are for factory-new quipment. Used alternators can be bought for eanuts—almost.

Least expensive are the 6-volt units, which re being advertised for $40 complete with ectifier and regulator and can occasionally be ound cheaper (at one time the author was ffered three new 6-volt alternators for $5 ach, complete). Used 12-volt systems can be urchased for $85. Best place to check for hese is in the classified ads of Ham Swap. If ou find none there, ask your local police-radio epairman.

Installation of an alternator is simple but irty. Remove your old generator and voltage egulator. Get a mounting bracket for your nodel auto from the local Leece-Neville or Delco distributor (average cost, $5). Bolt the alternator in place where the generator came out, and install the regulator in place of the old regulator. The rectifier can be mounted either on the fender or behind the grille, depending on space available in your engine compartment.

If you get a new alternator, it will include a cable kit. A used one may not include the cables. If you have no cables, make them from No. 0 welding cable to the size necessary. Follow the schematic diagram, Fig. 1, for routing of wires and connections.

If your battery has been in service for some time, it will be best to replace it when you install the alternator. Get a good, glass-plate unit, and you'll never have a dead battery again. Batteries which have been allowed to remain partially discharged, as is the usual case with a generator-type system, usually go completely dead as soon as the high output of the alternator hits them.

With an alternator installed, your autopower problem is solved. But that's just half the story—for ac, even 700 watts of it, won't do much for your signal strength. You're going to have to change it to dc to use it.

Vibrapacks, dynamotors, and transistor power supplies can all be used successfully without worrying about battery drain, but there's a far cheaper way once you have an alternator installed. That's construction of a supply which works direct from the alternator. Efficiency ranges higher than 90 percent with such a supply, and there's no wear and tear on the battery or regulator either.

In a 12-volt system, alternator output will be 14 volts, 3-phase, ac, and the frequency will vary from 80 to 1000 cycles as you speed or slow the engine. Conventional 60-cycle power supplies don't perform well under these conditions.

However, a 3-phase high-frequency supply can be easily built using mostly-surplus parts, and the combination of the alternator system and the 3-phase power supply will cost only

slightly more than would a conventional transistor power supply to be used with conventional auto systems.

A schematic diagram of such a unit, designed for 500 volts output at 500 ma (enough to power a 200-watt final and leave 50 watts to drive the exciter), is shown in Fig. 2.

In building the power supply, surplus 400-cycle transformers which can be obtained for less than 50¢ each can be used for the 3-phase step-up system. Proper phasing is essential for correct operation. It can be assured if identical transformers are used for the three legs. Proceed as follows:

Mark one secondary terminal of each transformer "1" and the other "2", taking care to make sure that the corresponding terminal on each transformer bears the same number (it makes no difference whether the start or finish of the winding is 1). Mark the primary terminals "A" and "B" in the same manner.

Connect the 6.3-volt secondaries all in series, terminal 1 of transformer I to terminal 2 of transformer II, terminal 1 of transformer II to terminal 2 of III, and terminal 1 of III to 2 of I.

Connect all "B" terminals of the 120-volt primaries together. Tape the connection. Take output from the "A" terminals.

The delta-connected secondaries are connected to the three output terminals on the alternator. The primaries go to the 600-vol silicon rectifiers as shown on the schematic.

Note that very little filtering is necessar with this circuit. Input frequency varies fron 80 to 100 cycles, and the delta-wye circuit ha only 4 percent ripple at the rectifier outputs (a a frequency six times the input frequency). Fo many applications, ripple is low enough wit no filtering. The choke and the .1 mfd capacito remove most of the residual 480- to 6000-cycl whistle.

If a lower-voltage supply is desired, use o 12.6-volt transformers in place of the 6.3-vol units will cut output voltage in half withou affecting current capability. Rectifiers the need be only 300-volt PIV rating. A dual-vol tage supply, convenient for operating exciter receiver, and final from the same unit, is bes achieved by use of a tapped bleeder as show in Figure 2.

This power supply brings an end to flea powered mobile operation by necessity—bu it does have one small disadvantage. It's this The auto motor must be running for operation In most cases, this is all to the good anyhow A fast idle is all that's needed.

Suggested final tubes for use with this cir cuit include four 6146, 807, or 1625; tw 4X150A, or any others capable of taking th high-current relatively low-voltage outpu Happy mobiling! 7

Cardboard Chassis

Jim Kyle, K5JKX/6

TRANSISTOR circuits, unlike their vacuum-tube counterparts, don't need large metal chassis to support the weight of the components.

This isn't news to anyone who's followed the transistor - construction - project literature. Nearly all construction articles specify punched phenolic cards for the chassis.

However, punched phenolic is available only by mail order in many areas, and in all cases proves a bit expensive for the ham with a limited budget. Here's a twist on the phenolic card chassis which retains all advantages and adds a few of its own. Use drafting board or other heavy cardboard instead!

Like phenolic, paper board is lightweight and is a good insulator at the voltages, currents, and frequencies generally encountered when working with transistors.

Unlike phenolic, paper board is easily worked with scissors and needles. Gone are the tedious hours with finetoothed saw and file.

Drafting board, in the small sizes generally used for transistor chassis, can usually be obtained for free from a friendly draftsma Lacking this opportunity, use photo mountin boards. They're available in 16 by 20 inch siz from any photographic supply house caterin to the advanced-amateur trade, for less tha 50 cents each. One mount board will furnis chassis for dozens of projects.

The only "special" tools needed to prepa a chassis are a pencil, ruler, pair of scissors sharp knife, and dividers or a large sewin needle. The dividers or needle are used punch component-lead holes.

First, cut the card to size. If you're plannin to put the finished unit in a Minibox or simila case, cut the card ¼ inch smaller than th inside measurement of the case. This allow room for mounting brackets.

Next, arrange the components on the card you want them. Try to keep all signal-carryin leads as short as possible.

When the layout satisfies you, mark the pos tion of each component and its leads on th card. It's helpful to transfer the schemat diagram to the card after the layout is made-

marking all connections and indicating all parts values. If you make the marks lightly, there'll be no danger of shorting out components with the pencil lines.

Now get out the dividers or needle and punch all holes. Transformers can be mounted by using a sharp knife to cut slots for the mounting ears.

With all holes punched, it's time to put the components in place. Thread the leads through the holes, and if necessary bend the lead flat against the backside of the card to hold the part in position.

The final step in this construction method is the soldering of all connections. Be sure to insulate bare conductors with spaghetti tubing to prevent accidental short circuits. When soldering semiconductors, use a pair of long-nose pliers between the semiconductor and the solder joint to act as a heat sink and prevent damage to the semiconductor.

That's all there is to it, basically. Here are some hints gathered through experience which speed cardboard-chassis construction:

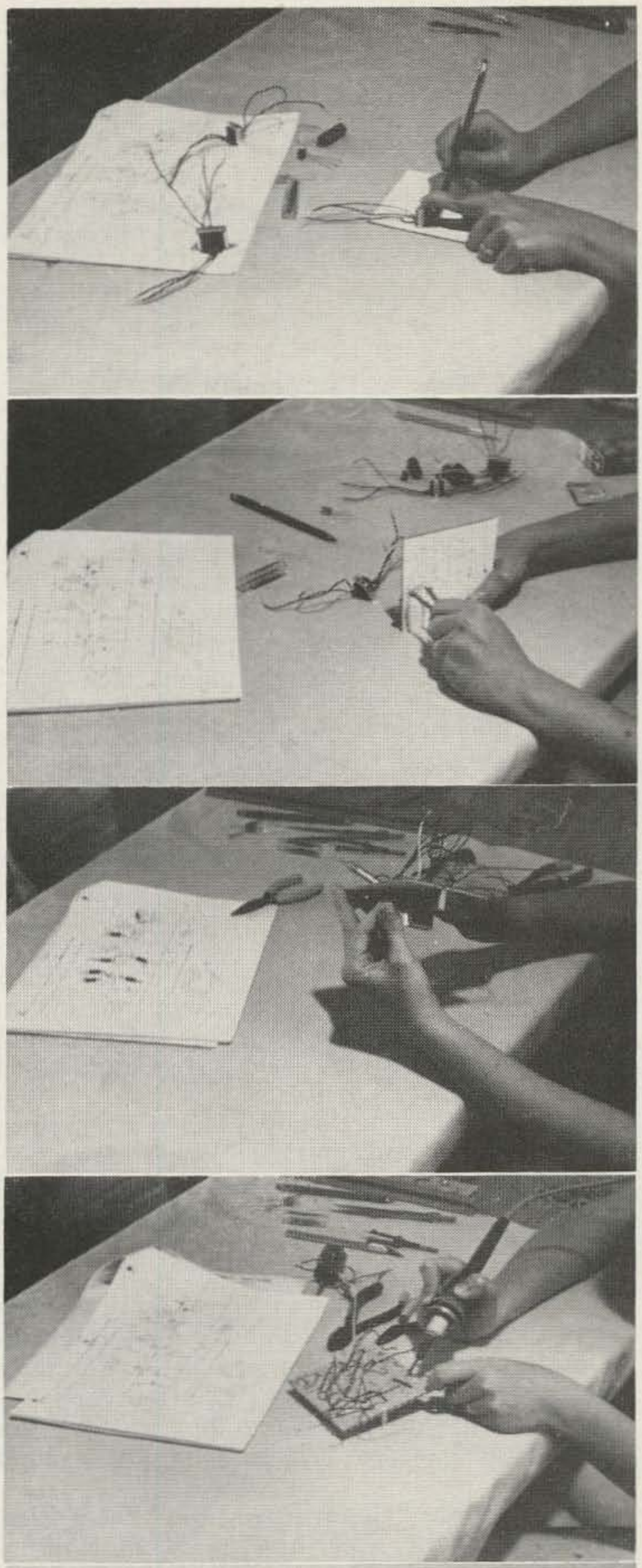
Transistor sockets and cardboard chassis don't go together very well. It's handier to omit the socket and wire the transistor directly into the circuit. Three small holes for the transistor leads hold the component more firmly than would a socket.

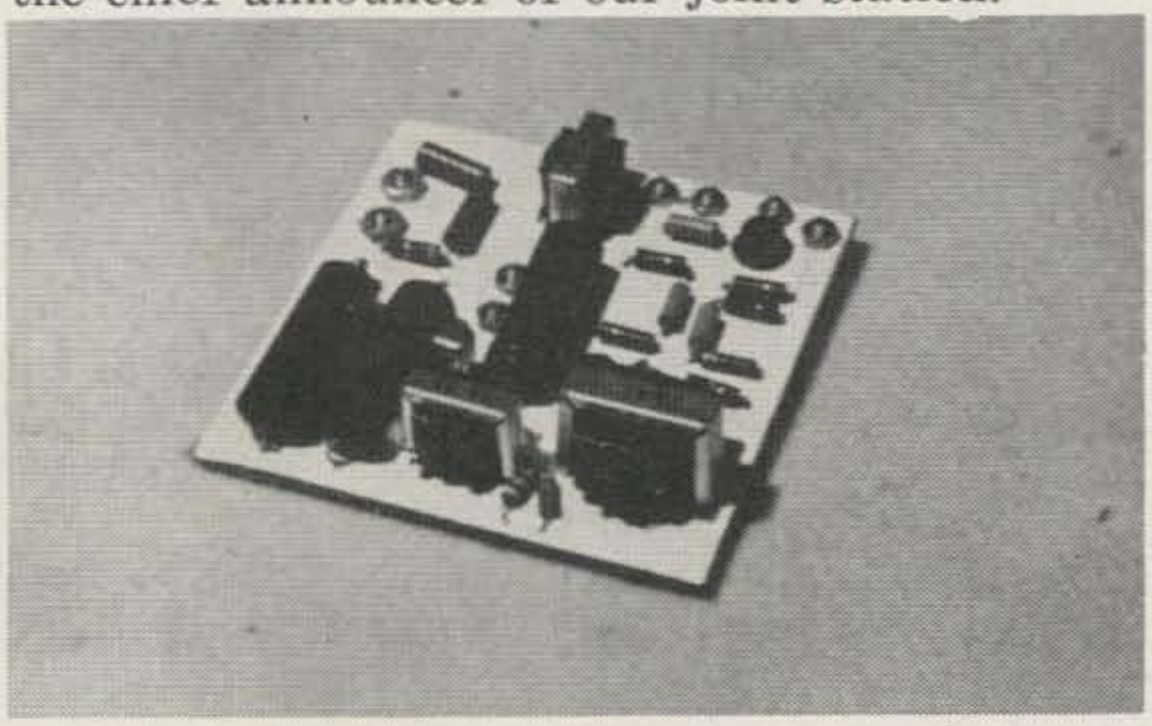
Connections to off-chassis elements should be routed through a binding post. Continual flexing of the lead can cause the wires to break. A 6-32 by ¼ inch machine screw through the cardboard, with its head at the back side of the chassis, works well. Solder a wire into the slot of the screw, using resin-core solder and a very hot iron, to make the connection to the chassis-mounted components.

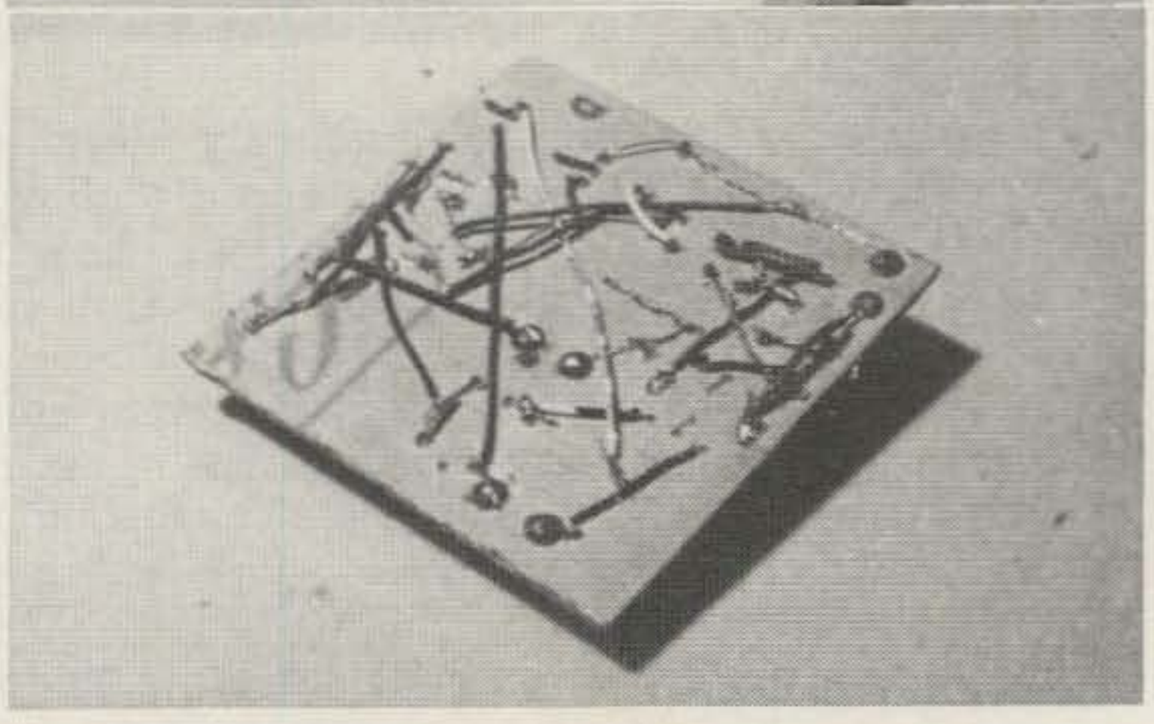
Circuit markings (terminal indications, identification of transistors or other components, etc.) hold up best if marked on the card with India ink rather than pencil.

When all wiring is complete and every joint soldered, a coat of clear plastic spray such as Krylon Automotive Grade will protect the finished project. If you need an especially-strong chassis, give the card three or four coats of plastic spray before mounting the components.

All other details are shown in the photographs, which feature the hands of K5QGO, the chief announcer of our joint station. 73







Stop That Noise!

73 Staff

PARTICULARLY when operating mobile, a good noise limiter in your receiver often makes the difference between a contact and a near-miss.

But what is a *good* noise-limiter circuit? This question has faced every ham at one time or another, since nearly every published circuit has at least one major disadvantage or another.

As in many other questions, the only answer to this one is, "It all depends on the situation." The noise limiter which one ham finds perfect may be completely unacceptable to another amateur because of differing requirements.

To help you decide which noise limiter is good for your needs, here's a more-or-less complete listing of the various circuits developed since the days when Signor Marconi tapped out "Sorry, QRN" to his colleagues and sat down to devise a way around static crashes.

Noise limiters can be classified in several manners, as series or shunt, audio or *if*, etc. Here, they're classified as peak limiters and trough limiters, since each of these types serves a separate purpose.

The peak limiter removes spheric crashes, key clicks, and ignition-noise signals from the receiver output, adding to the pleasure of operating. Virtually all limiters included in commercial gear fall into this category.

The trough limiter removes all signals below a certain preset level and allows only signals above that level to pass. It has no effect on ignition or other high-peak noise, but will remove every trace of receiver hiss. When properly adjusted, it will pass more than 90 per cent of an audio signal while erasing all background noise.

Peak limiters fall into two broad categories, series and shunt, according to circuit configuration. Each type has its disadvantages and its advantages.

The series peak limiter generally does a more effective job of removing signals above limiting level than does the shunt type, but it does so at the cost of increased distortion of the limited signal.

The shunt peak limiter is the easiest to add to an existing circuit without changes. Its main disadvantage is a small amount of leakthrough, which shows up as weak noise pulses getting through the limiter.

The series peak limiter consists of a diode, biased for switching action, connected in series with the audio signal path through the receiver. This diode circuit may be either half-wave or full-wave.

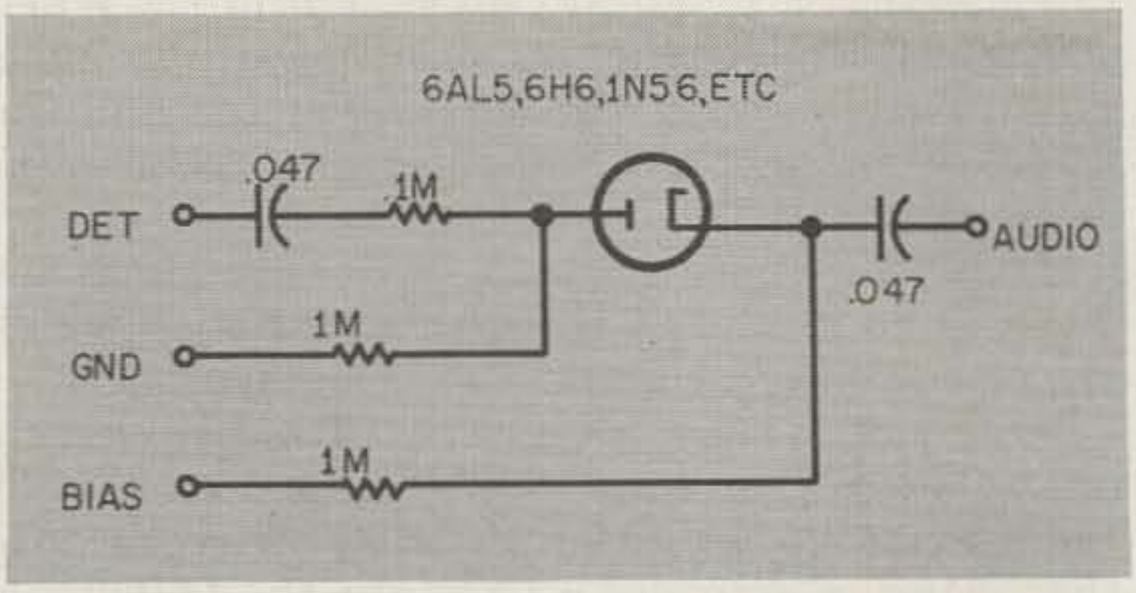


Fig. 1—Half wave series peak limiter.

The half-wave series peak limiter's schematic diagram is shown in Fig. 1. It may be built on a small card chassis and inserted in any receiver as illustrated in Fig. 2. Semiconductor diodes work in this circuit, but be sure to use a unit with high back resistance such as the 1N54. The base-emitter junction of any common transistor (2N107, CK722, etc.) also makes a good diode for this purpose.

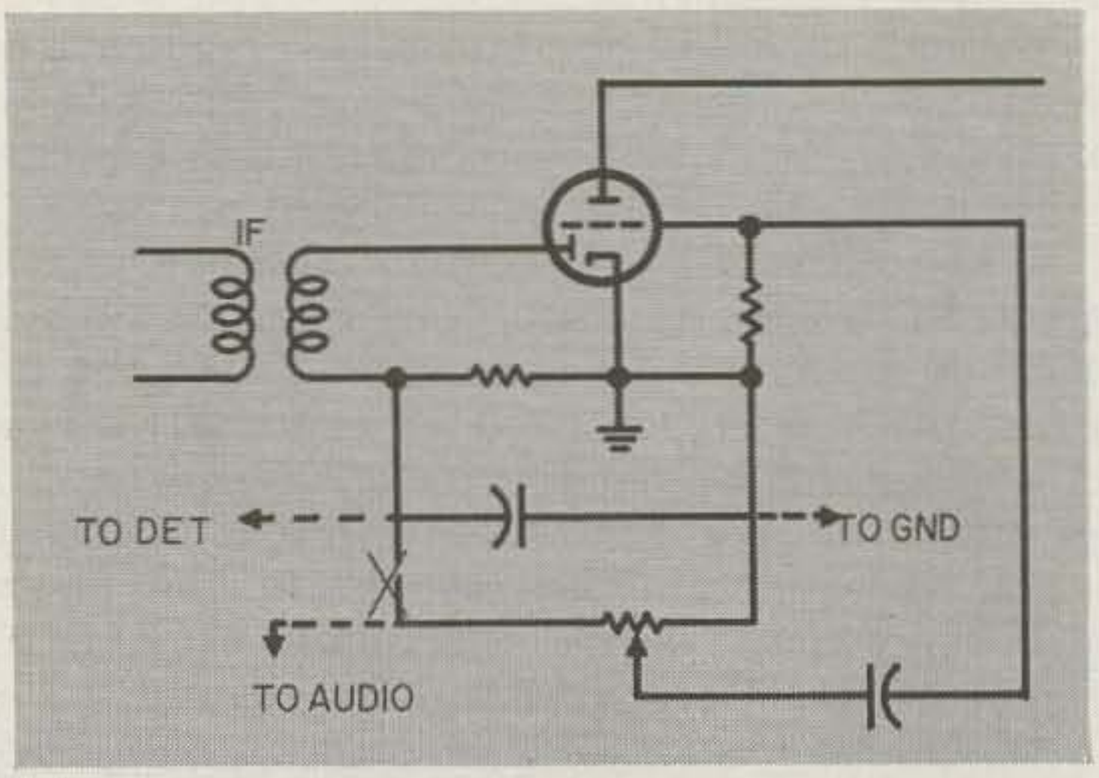


Fig. 2—Connection of series peak limiters.

Here's how it works. The audio signal out of the detector is fed through the input resistor to the diode. When the audio signal is less than the diode bias voltage, the diode is conducting and appears as a short circuit. This lets the audio through to the output side, from whence it proceeds to the rest of the receiver.

A positive peak signal greater than the diode bias voltage drives the diode's cathode positive to its anode, switching it off. There is then no

path for the audio from the detector to the rest of the receiver, and the pulse peak is limited. When the peak passes, the diode recovers and restores the audio path.

A negative peak signal greater than the diode bias voltage will not be affected by the half-wave limiter. However, negative-peak audio (which is positive-peak at the detector input due to phase inversion) is automatically limited at the detector to zero. If the incoming signal is 100 percent modulated, negative peaks will pose no problems.

The full-wave series peak limiter, shown in Fig. 3, was developed to overcome the lack of

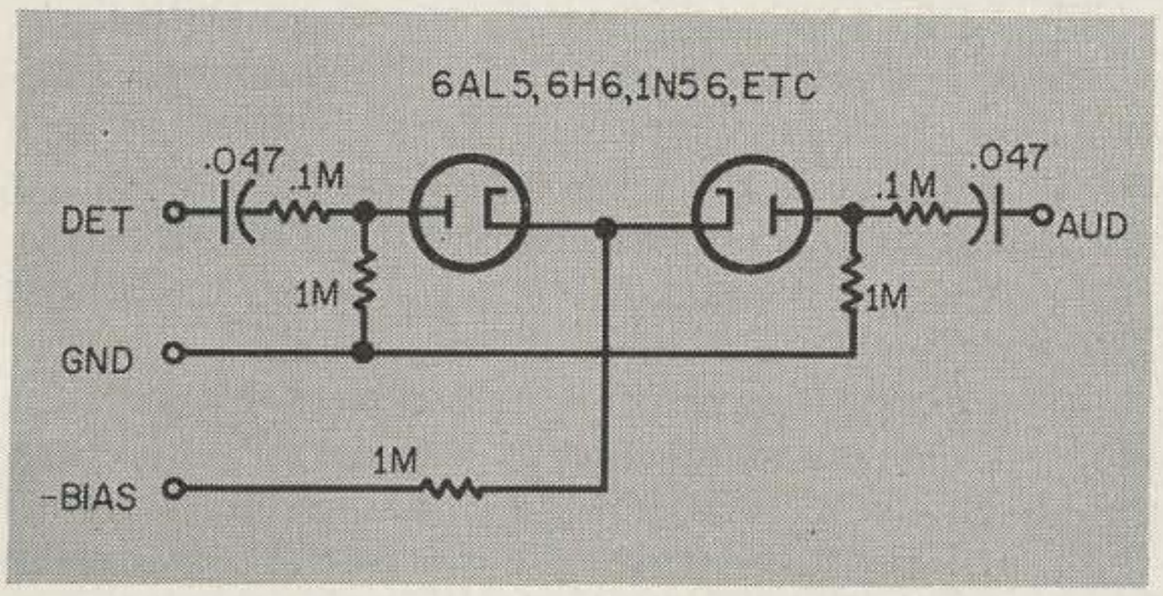


Fig. 3—Full wave series peak limiter.

negative-peak limiting (which proves a handicap if incoming signals are not fully modulated) in the half-wave circuit.

Using nearly twice as many components, this limiter circuit provides positive control of both positive and negative peak levels. It is probably the most effective of all peak-limiter circuits.

Its operation is the same as the half-wave version on positive peaks. Negative peaks above limiting level cut off the other diode in a similar fashion. Limiting level can be varied from less than 10 percent modulation to 100 percent modulation by adjusting diode bias voltage accordingly.

Another version of the series peak limiter, using a triode instead of diodes, has been widely used. It is standard equipment on many of the older Hammarlund sets, notably the early Super-Pro line, the BC- versions of the Pro, and the HQ-129X. The BC-779 version is shown in Fig. 4.

This limiter depends on controlled cathode temperature to achieve its effect, rather than on biased-diode switching. Although it's a bit more complex, it's also more effective than the half-wave diode circuit.

Incoming signals are passed by the triode in cathode-follower fashion so long as they are below limiting level. However, pulse peaks are stopped because the tube runs into saturation-produced by the lower-than-normal filament temperature due to the resistor, and by the low plate voltage. Limiting level is automatic since plate voltage varies with incoming carrier strength.

The filament resistor to produce lower cathode temperature is a good trick to use with any noise limiter, if you use tube-type diodes. It increases reverse resistance and makes the transition from conduction to non-conduction more sharp.

Incidentally, the 'AL5 series of tube-type diodes is generally superior to the 'H6 series in

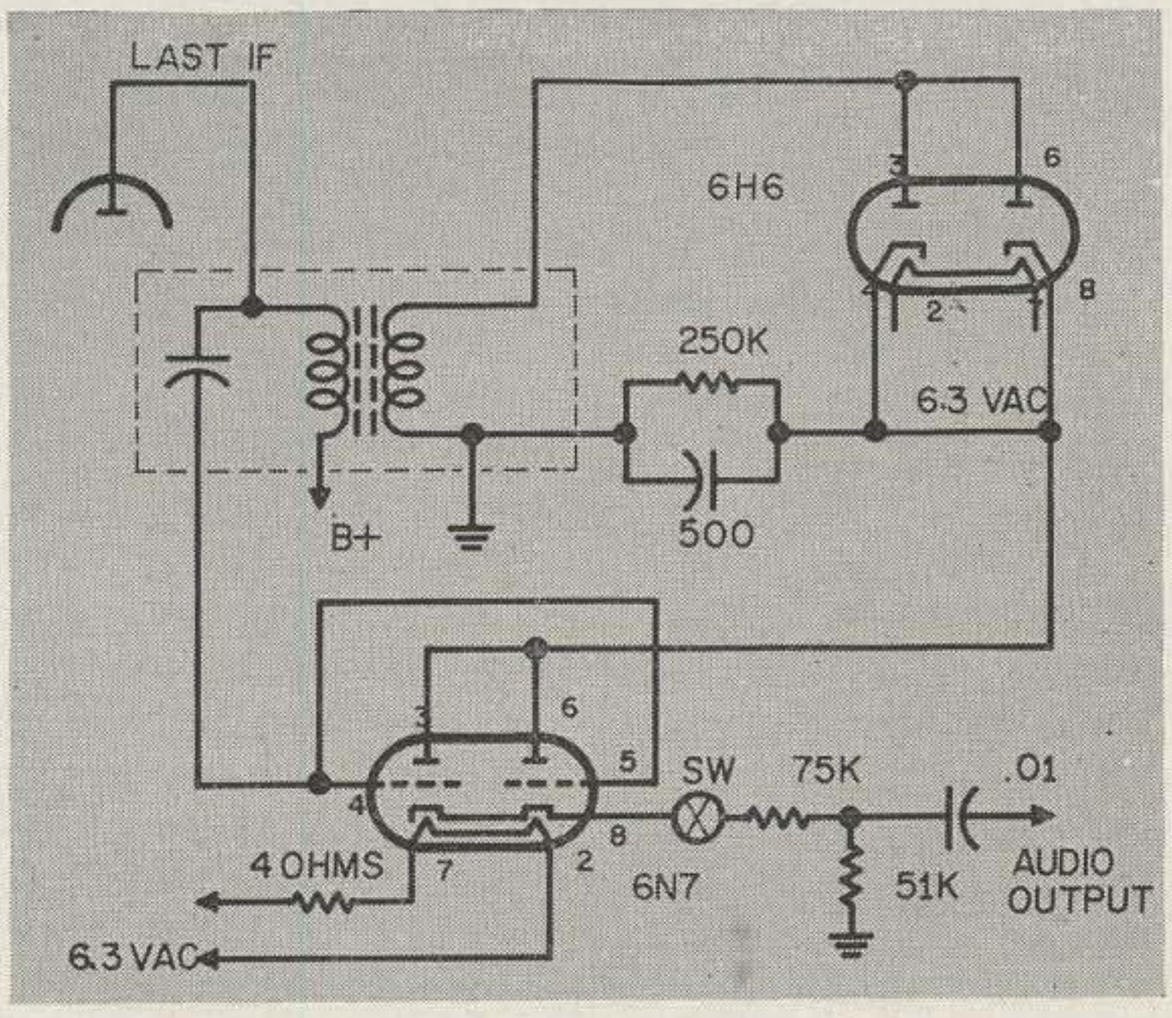


Fig. 4—Hammarlund limiter in BC-779.

noise-limiter service.

The shunt peak limiter is connected in parallel with the audio signal path, rather than in series. Like the series limiters, it may be either a half-wave or a full-wave circuit.

The half-wave shunt peak limiter shown in Fig. 5 is probably the simplest and least expensive noise limiter you can add to any set. With only two components, it adjusts itself automatically to variations in carrier strength. Positive peaks are limited to a value twice that of carrier voltage, while negative peaks are not affected (as explained in the discussion of

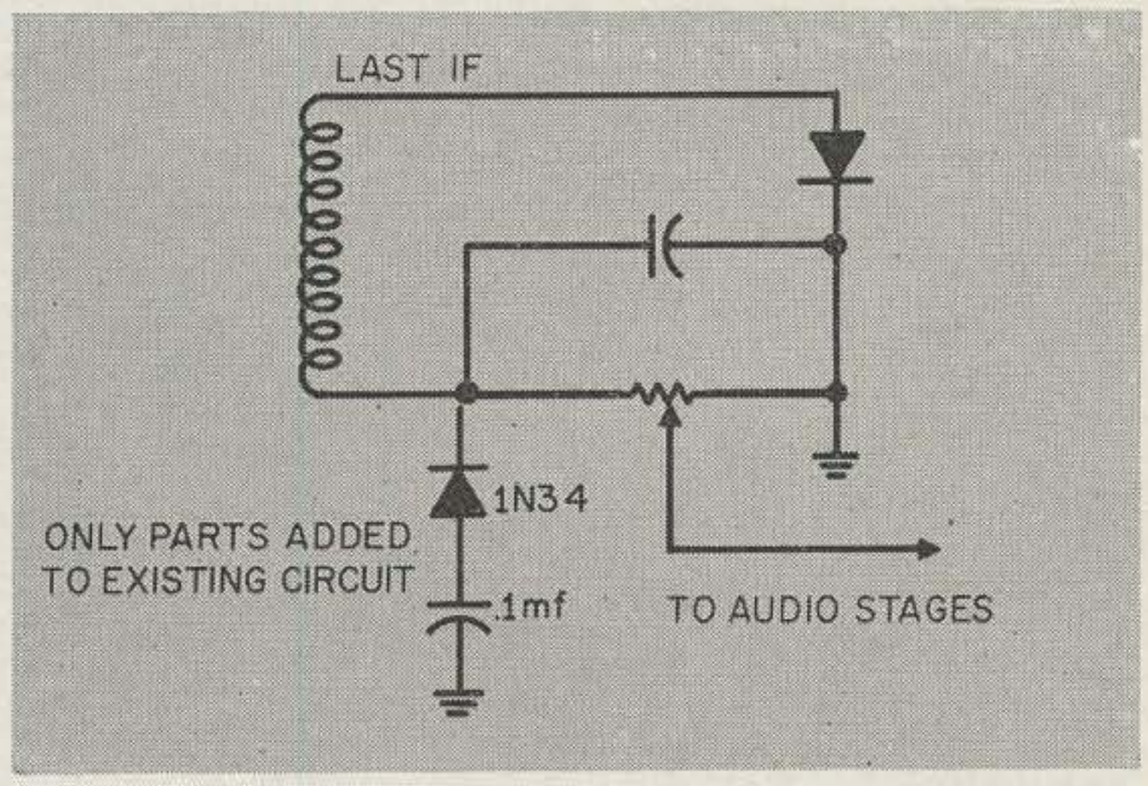


Fig. 5—Simple half wave shunt limiter.

half-wave series limiters).

The shunt peak limiter discussed thus far was, like its series equivalent, confined to audio-peak devices connected to the set at the detector output. This is not the only manner in which the shunt peak limiter can be used.

Shunt audio peak limiters can also be connected at the speaker as shown in Fig. 6. Selenium or silicon rectifiers with at least a

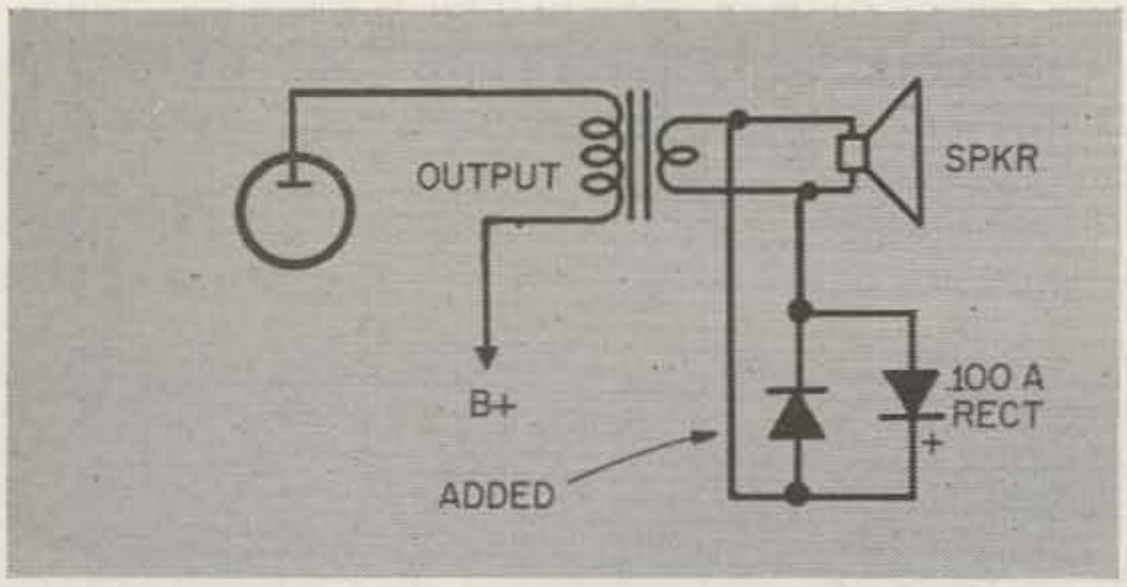


Fig. 6—Speaker shunt limiter.

100 ma rating are recommended for this circuit in preference to tubes or smaller crystal diodes. The full-wave circuit is necessary here.

The speaker-attached limiter has the advantage of simplicity, ease in connection, and adaptability to any receiver without going into the chassis. However, its disadvantages are numerous: It does nothing to the noise peaks before they arrive at the speaker, thus allowing audio stages to overload and to "ring." It has no effect on medium-level noise peaks, thus allowing much ignition noise to get through. Finally, its limiting level is not adjustable, being dependent solely on the characteristics of the particular rectifiers used.

Another point at which the shunt peak limiter can be used is ahead of the detector, in the *if* stages. Many authorities recommend that noise pulses be eliminated as early in the game as possible, thus avoiding overload of *if* as well as audio stages.

The original *if* limiter was devolped more than 25 years ago by Lamb, and is still in use in several receivers—notably, the Pierson and the venerable SX-28 by Hallicrafters.

In this circuit a separate *if* amplifier feeds a noise detector. The output of the noise detector, at a level determined by the limiting-point adjustment, is fed back to the first *if* stage to cut the amplifier off in the presence of a noise pulse.

The original circuit fed the noise detector output to the *if* tube by direct coupling. This allowed a steady but strong carrier a few kilocycles away from the desired signal to cut off the *if* stage even in the absence of noise pulses.

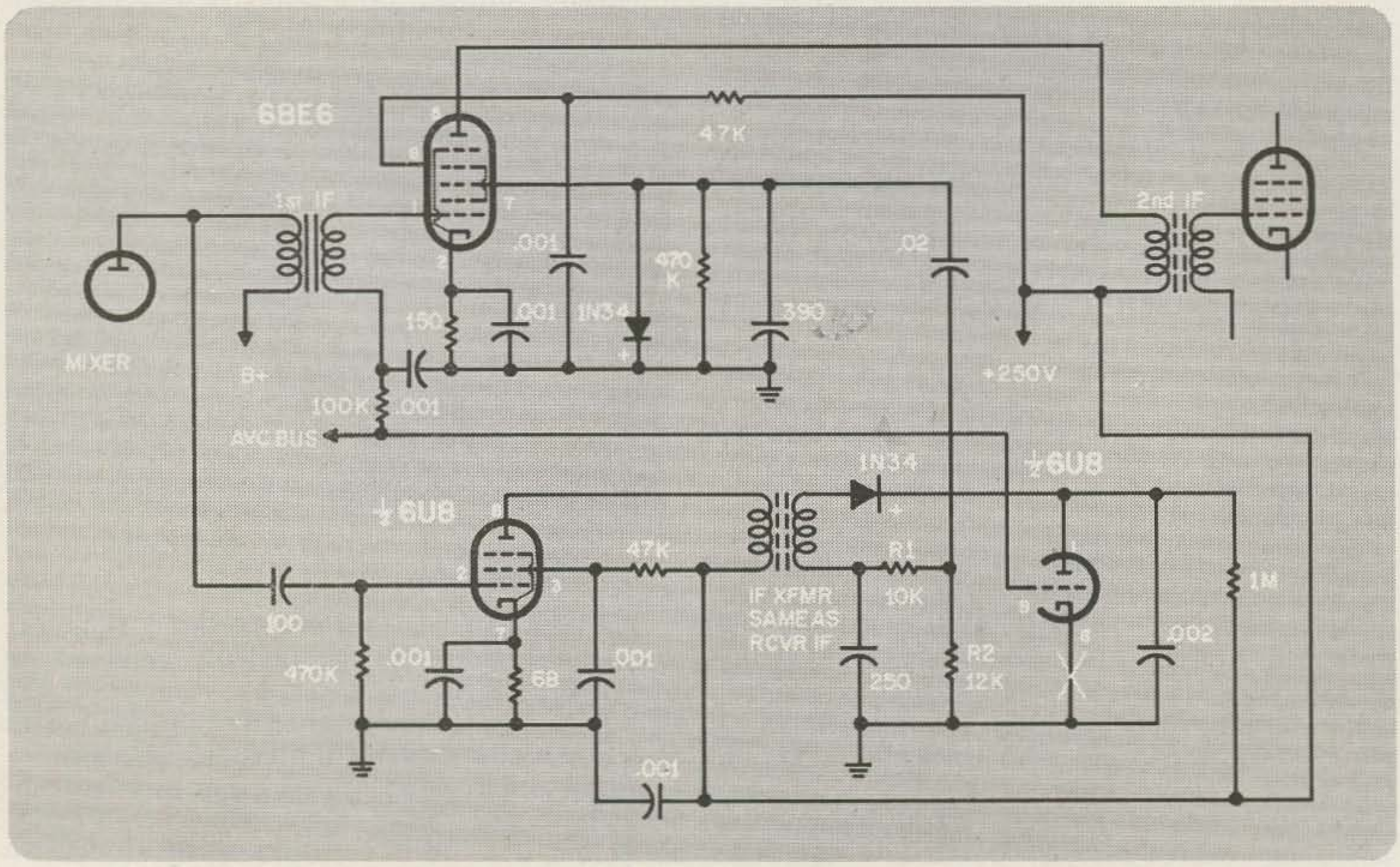
The Pierson version of the Lamb limiter, with ac coupling from noise detector to controlled stage, overcomes this difficulty. An adaptation of the Pierson-Lamb limiter is shown in Fig. 7. It may be built on Vector turret sockets and permanently mounted in almost any receiver.

Advantages peculiar to the Lamb circuit are the suppression of noise pulses *before* they reach the selective *if* circuits and cause ringing; an almost total lack of audio distortion common to most other limiters, and suppression of noise pulses ahead of the AVC line which prevents noise from reducing receiver sensitivity.

The major disadvantage of the Lamb circuit is its complexity. The cost of installing this limiter will run approximately twice that of any other limiter. The extra *if* stage also provides additional sources of trouble as the receiver ages.

Working from the same basic premise stated

Fig. 7—Modified Pierson-Lamb limiter.



y Lamb in 1936—that a noise limiter should e as close to the receiver input as possible—ther designers have developed *if* shunt peak imiter circuits which overcome most of the Lamb limiter's disadvantages. One of these is llustrated in Fig. 8.

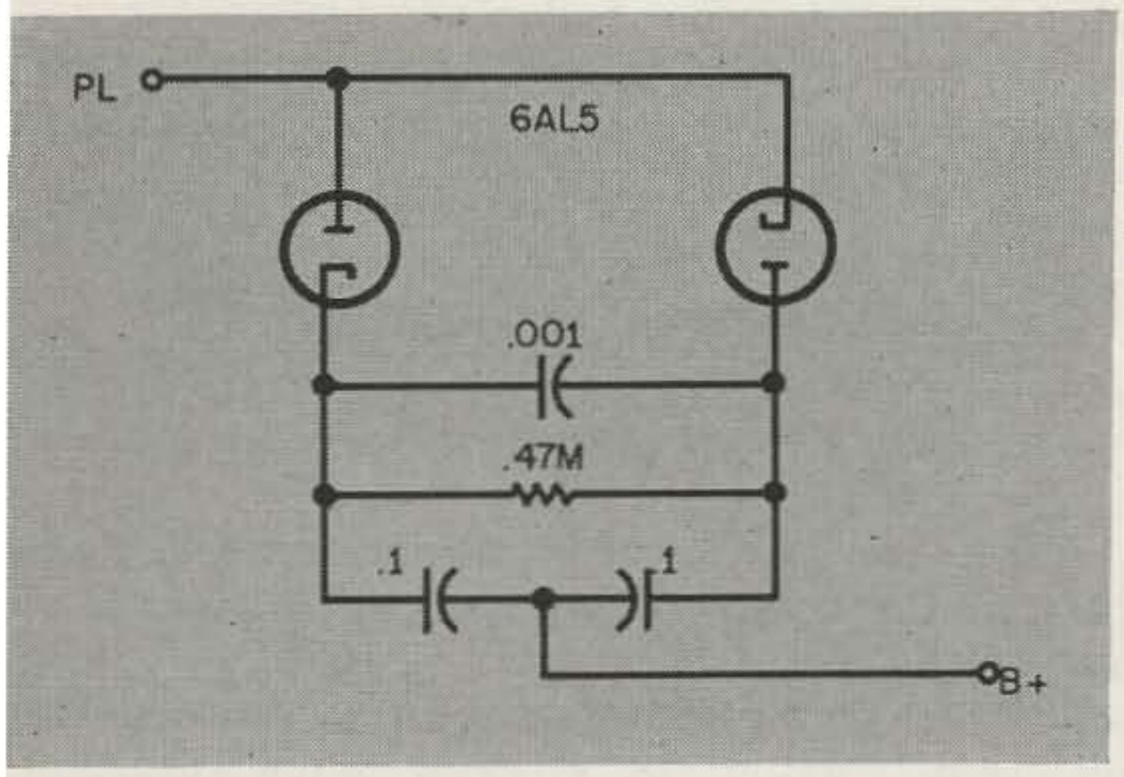


Fig. 8—IF automatic shunt peak limiter.

Operation of this limiter isn't so obvious as ome of the other circuits. With a noise-free nd steady carrier tuned in, there will be a mall voltage drop across the *if* transformer rimary. The two .1 capacitors are charged through the diodes and the resistors) by this oltage.

Each capacitor assumes polarity opposing urrent flow through its associated diode. Un-er these conditions, the diodes are open cir-uits across the *if* transformer primary and he limiter has no effect on the signal.

When a high-amplitude noise pulse comes long, though, the picture changes. The pulse vercomes the bias on one of the diodes (which ne depends on polarity of the pulse) and rives the diode into conduction. In this state, he diode is a virtual short across the *if* trans-ormer and virtually no signal gets through. Vhen the pulse passes, the diode opens up utomatically and the signal proceeds.

Operating as it does from the voltage drop cross the transformer primary, this circuit utomatically adjusts itself to varying signal trength to provide limiting at the 100-percent ıodulation point. Connections to any receiver re shown in Fig. 9.

Note that peak limiters in Figs. 1, 3, and 5 re shown with manually-controlled bias

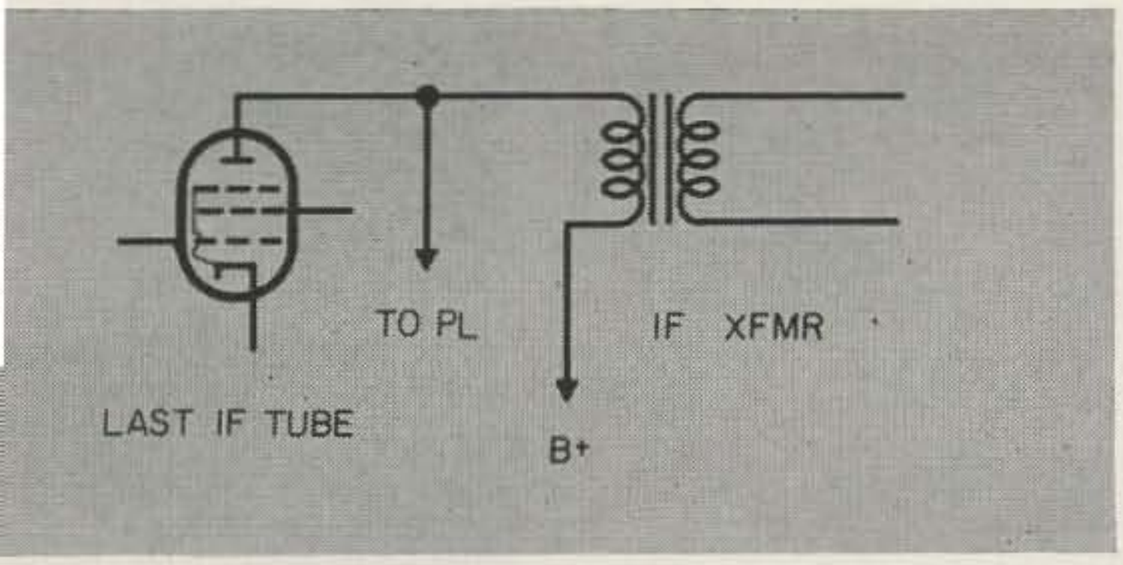


Fig. 9—Connection of IF shunt limiter.

Most operators prefer that their noise limiters be automatic. It's no trouble to make the change in the circuit. Since all circuits shown are arranged for negative bias voltage, the receiver AVC line provides a handy source of bias voltage.

If AVC is applied directly to the bias-voltage input of the limiter, noise peaks will be allowed to rise to twice the peak audio value before being limited. This is because the AVC level represents peak-to-peak value of a 100-percent modulated signal, while the audio peak value is never greater than half this amount and frequently is as low as 25 percent.

The best source of bias voltage for noise-limiters is obtained by removing the AVC detector load resistor from the receiver and replacing it with a potentiometer of the same value. Bring the limiter-bias voltage off the arm of the pot. Adjusting the potentiometer will then give you limiting at any point from 0 volts to twice peak audio level.

For a vernier adjustment, use a potentiometer just half the value of the load resistor and add a fixed resistor in series to restore the original resistance. This gives a range of adjustment from zero to peak audio level.

TNS

Before progressing from peak limiters to trough limiters, a word should be said about the popular TNS developed by W2AEF. Combining noise limiting with squelch action, this may well be the most popular of all limiters for mobile use.

So far as the limiting portion of the TNS is concerned, it's a full-wave series peak limiter. After limiting, the signal is applied to a twin triode which has different time constants in the two plate circuits.

This tube is triggered by the switching action of the limiter diode in such a manner as to prevent any portion of the noise pulse from passing through. (Other limiters hold the pulse to a level consistent with the audio signal, but leave the "stump" of the noise in the signal.)

By adjusting the time constant of one half of the triode, the TNS squelch level may be set at any desired value.

Since it has been adequately described at length in Bill Orr's "Mobile Handbook" the TNS circuit is not shown here.

Advantages of the TNS have already been explained. Here are its disadvantages: Signal input level is critical, in comparison to other limiters. Any signal in excess of 10 volts produces serious distortion. In addition, setting of the squelch control is somewhat of a "hairline" business. Set for too high a level, it prevents weak signals from being heard. Set at the critical point for weak signals, it will be triggered by passing trucks and emit a raucous burst of sound.

These points, however, are minor. The

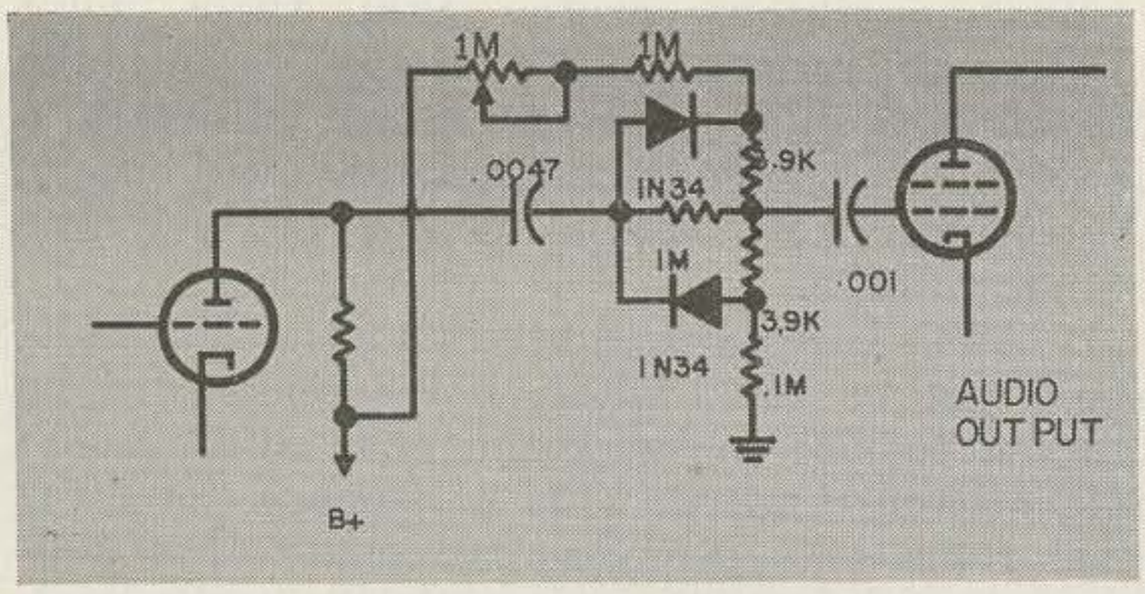


Fig. 10—Trough limiter.

worst disadvantage of the TNS circuit is the one it shares with the Lamb limiter—circuit complexity. With two tubes, a squelch control, and two RC networks, it's virtually impossible to cram into an already-crowded receiver chassis. Most users build it into a Minibox and mount it near the receiver with long leads.

Many noise limiter circuits not shown here have been published. Virtually all, however, are variations on one or more of these basic peak limiter circuits. Now, it's time to look at the other classification—the trough limiter.

Trough Limiter

The trough limiter, an adaptation from computer circuitry, has made only one previous appearance in print to the writer's knowledge. This handy little circuit erases background noise but lets the audio signal through.

This feat is accomplished by limiting, not the peak level, but the trough value of the audio wave. Instantaneous voltages below the limiting level are suppressed, while all above the level go through.

This works with speech because of its syllabic power content — the same reason that SSB amplifiers have a high power rating and that clipping helps increase AM transmitter talk power.

Experiments have shown that more than 10 percent of an audio signal can be removed without losing intelligibility. The trough limiter removes only the low-level portion of the signal—but at the same time eliminates all background hiss.

Although trough limiters can be built in either series or shunt, half-wave or full-wave configuration, only the full-wave series circuit proves practical for communications work (if you like to experiment, any peak limiter using diodes can be converted to a trough limiter by reversing polarity of the bias voltage).

Such a circuit, including its connections to the receiver, is shown in Fig. 10. It may be built on a card or phenolic "chassis" and permanently mounted in the receiver.

In operation, the diodes are biased for nonconduction without signal. Any signal voltage lower in value than the bias level finds an open circuit at the diode and cannot reach the output stage. Bias level is chosen so that random noise is just below the bias-voltage value.

Signal voltage higher than the bias value forces the diodes into conduction, thus closing the circuit to the output stage and allowing audio through.

That wraps up this discussion of noise-limiter circuits, with advantages and disadvantages listed for every type. With this information, you can now answer for yourself that question, "What is a good noise limiter?" Simply pick the one whose advantages, for your needs, outweigh its disadvantages, again balanced against your own requirements.

If you want to go deeper into the theory and design of noise limiters, a number of reference works and articles used in the preparation of this article are listed in the bibliography. Happy mobiling! 7 3

BIBLIOGRAPHY

1. **French, W1JKZ,** The Zero Clipper, *Radio and Television News,* May, 1958, page 40.
2. **Goodman, W1DX,** The Pierson KE-93 Receiver, *QST,* May, 1957, page 43.
3. **Langford-Smith,** *The Radiotron Designer's Handbook**, pages 694-699 and also page 1131.
4. **Orr, W6SAI,** *New Mobile Handbook**, pages 81-91.
5. **Orr, W6SAI,** *Radio Handbook**, 15th Edition, pages 227-231.
6. *Radio Amateur's Handbook,* ARRL.
7. **Stiles, K5ENB,** IF Noise Limiter, *QST,* June, 1960 (see also reference 5, page 229, for this circuit).
8. **Terman,** *Electronic and Radio Engineering**, 4th Edition, pages 618-621.
9. **Toth,** Noise and Output Limiters, *Electronics,* Nov. 1946, page 114; Dec. 1946, page 120.

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Measure Your Modulation

Jim Kyle, K5JKX/6
1851 Stanford Ave.
Santa Susana, Calif.

IF YOU'RE still using AM (as many of us are), you know that you must have adequate modulation level to achieve successful communication.

Many conscientious hams use scopes to monitor their modulation level and guard against overmodulation with its consequent splatter and chances of pink slips. Few, though, have any idea just how great their average modulation level is.

Here's a simple overlay screen for your mod-monitor scope which will tell you your modulation percentage at all times. With this knowledge, you can then do what you like to raise the percentage as close to 100 as you dare.

To use the overlay, have a positive photocopy made at a commercial blueprint supply house, in the right size to fit your scope screen. The exact size you need is determined mainly by your mod-monitor circuit, but the long, vertical side of the trapezoid pattern must touch the two outside lines of the overlay.

The illustration is printed in the proper proportion for many mod-monitors. If the size is right for your monitor, simply trace it from the page onto clear acetate, using India ink and a fine-pointed pen.

Whichever route you take, when you have the finished overlay ready affix it to the face of your scope tube with transparent tape so that the dotted vertical line and the long line marked "100" cross at the center of the tube and the 100 line is parallel to the horizontal deflection of the tube.

Turn on the transmitter and apply a test one. This may be some 60-cycle ac coupled into the audio from a filament line, or the output of a test oscillator. Whistling into the mike won't produce a steady enough output to adjust the monitor.

Adjust the coupling between the monitor rf input and the final until the vertical peaks of the trapezoid pattern barely touch the "0" lines of the overlay. The overlay may require adjustment up or down to make both lines touch the pattern at the same time.

If necessary, adjust the monitor's horizontal gain control so that the point of the trapezoid (or the short edge, if your pattern doesn't come out to a point) falls in the area covered by the short lines of the overlay.

Now all you have to do is note which overlay line the short edge of the trapezoid rises to, and read off modulation percentage directly. Note that levels higher than 90 percent are almost unreadable—if you reach this level, you'll get out. Broadcast stations are only required to maintain a level of 85 percent.

Here's how the measuring gadget works:

By definition, the modulation percentage of an AM signal is expressed by the formula

$$\frac{E_{crest} - E_{trough}}{E_{crest} + E_{trough}} \times 100.$$

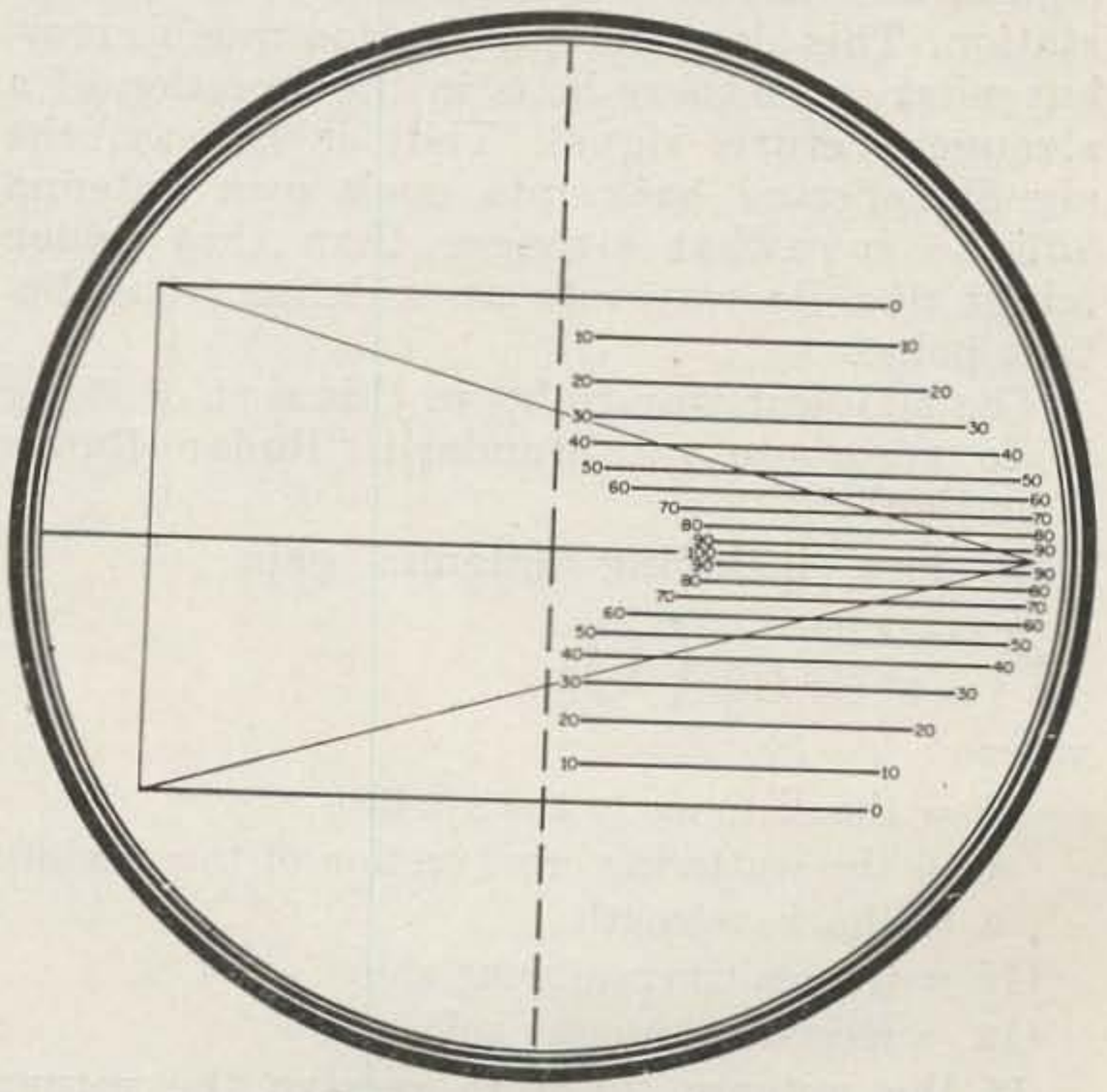
E_{crest} is the peak voltage, and E_{trough} is the minimum voltage, during a modulation cycle.

The conventional trapezoid pattern of a mod-monitor portrays this relationship graphically. The high end of the trapezoid is a measurement of peak voltage, and the low side measures minimum voltage. Audio voltage fed to the horizontal plates simply provides a sweep directly proportional to the modulation cycle.

The overlay pattern is a calculation of the values of minimum voltage for arbitrary modulation levels, in terms of the peak voltage.

Therefore, when peak voltage is adjusted—

(Continued on page 56)



Some Hard Facts About Echo

Don Goshay W6MMU
8352 Westlawn Avenue
Los Angeles 45, California

WELL, the long-awaited balloon is now in orbit, and a spectacular thing it is. Before I read the newspaper, I was aware something big was up (no pun intended) by the space talk across the 144 and 220 mc bands. Soon I came across W6BUT and W6DQJ on two meters making ready to try some balloon bounce on 1296 mc. Fine idea, I thought, and rushed about setting up the 4 foot dish and the crystal controlled rig on 1296 mc.

After the balloon had crossed the sky and no signals were heard, calm again prevailed. I began to wonder just how loud these signals from 1000 miles out in space should actually be. I recalled doing some moonbounce computations a few years ago and dug them out. The moon return signals were weak (on paper), so weak in fact, that only with high power output, large antennas, and extremely sensitive receivers with narrow bandwidth, could the job be done. The W4AO, W3GKP, W6QKI, and W2NLY experiments a few years ago had verified this. In fact, these brave fellows were successful in getting moon returns only a fraction of the times attempted.[1]

So, a similar computation was made for the case of the satellite. First, the satellite was assumed to be a perfect spherical reflector with a scattering cross-section equal to a flat disc of the same diameter.[2] This is actually an accurate approach for a sphere of any wavelengths in diameter. Next, I was interested in determining the strength of my own return signal, and not that reflected to some distant station. This does not involve too much error, but what error there is, is in the direction of a stronger return signal. That is to say, the signal reflected back into one's own antenna will be somewhat stronger than that which might find its way into an antenna at a distant point.

The simplest way to begin this sort of thing is to resort to the standard "Radar Range Equation":[3]

Path loss, including antenna gain

$$= \frac{(4\pi)^3 R^4}{\sigma \lambda^2 G_T G_R} \quad (1)$$

where

R = the distance to the satellite
σ = the scattering cross section of the satellite
λ = the wavelength
G_T = transmitting antenna gain
G_R = receiving antenna gain

If the antenna used to receive the return signal is the same as that which transmitted it, or if separate but similar antennas are used, Gt will equal Gr and then the expression GtGr can be called simply G^2. For a parabola:

$$(2) \quad G = (.5) \frac{4\pi A}{\lambda^2} = \frac{2\pi A}{\lambda^2} \text{ OR:}$$

$$G^2 = \frac{4\pi^2 A^2}{\lambda^4} \quad (3)$$

where A is the physical area of the parabola. Also, for a parabola:

$$(4) \quad A = \frac{\pi d^2}{4} \text{ AND } A^2 = \frac{\pi^2 d^4}{16}$$

where d is the diameter of the parabola. If (5) is substituted for A^2 in (3):

$$(6) \quad G^2 = \frac{4\pi^2}{\lambda^4} \frac{\pi^2 d^4}{16} = \frac{\pi^4 d^4}{4\lambda^4}$$

From the assumptions made regarding the scattering property of the satellite:

$$\sigma = \frac{\pi D^2}{4}$$

where D is the diameter of the satellite.

If equations (6) and (7) are substituted for GtGr and in equation (1), the following is the result and defines the total path loss:

$$\frac{Pt}{Pr} = \text{PATH LOSS} =$$

$$\frac{(4\pi)^3 R^4}{\frac{\pi D^2}{4} \lambda^2 \frac{\pi^4 d^4}{4\lambda^4}} = \frac{1024 \lambda^2 R^4}{\pi^2 D^2 d^4} \quad (8)$$

The ratio of the signal received to the signal transmitted is the reciprocal of this:

$$\frac{Pr}{Pt} = \frac{\pi^2 D^2 d^4}{1024 \lambda^2 R^4} \quad (9)$$

Equation (9) shows that the magnitude of the signal received for a given amount of transmitter power will be directly proportional to:

1) The *square* of the satellite diameter.
2) The *fourth power* of the parabola diameter.

The received signal will be inversely proportional to:

1) The *square* of the wavelength.
2) The *fourth power* of the distance between the antenna and the satellite.

If equation (8) is worked out for the case of ECHO I for 1296 mc and 4 foot dishes, the result indicates a path loss of at least 223 db.

Now if some lucky ham has a 500 watt output (not input) klystron on 1296 mc, his return signal will never exceed —166 dbm when using

a 4 foot parabolic antenna. If this same fellow has a 1296 mc receiver with a 2 db noise figure (assuming his parametric amplifier is working well), and his *if* strip has a bandwidth of 5 kc, he will just be able to hear a signal of —146 dbm. This means the signal he is looking for will never be any better than 20 db (100 times) below the receiver noise level. This is provided, of course, that his antenna is tracking the satellite perfectly.

The situation could be improved, on paper, by using a larger antenna. But this would narrow the antenna beamwidth and complicate the tracking problem sufficiently to make it impossible, except for the most sophisticated tracking systems.

The next question that might be asked is "how does this performance compare with that when using the moon as the passive reflector?" While the moon is much larger than the 100 foot satellite, is is 239 times as far away. The return signal depends on the *square* of the reflector diameter, but gets weaker by the *fourth power* of the distance.

$$\text{Path loss} \propto \frac{R^4}{D^2}$$

$$\frac{\text{moon path loss}}{\text{balloon path loss}} = \frac{\frac{R^4_{MOON}}{D^2_{MOON}}}{\frac{R^4 balloon}{D^2 balloon}} = \frac{\left(\frac{R_{MOON}}{Rbaloon}\right)^4}{\left(\frac{D_{MOON}}{Dballoon}\right)^2}$$

$$= \frac{(239)^4}{\left(\frac{2150 \times 5280}{100}\right)^2} = \frac{32.8 \times 10^8}{139 \times 10^8} = .236 = -6.3db$$

This means that the moon path loss will be about 6 db less than the satellite path loss, or, in other words, the received signal would be 6 db stronger from the moon. This is provided that the moon had as good a reflection efficiency as the balloon. In reality, it does not. A rough guess would indicate the received signal would be about the same in either case.

So if you have been unable to communicate via the moon, the foregoing analysis indicates you will be unable to do so via the ECHO I satellite with the same equipment. The problem is compounded by the satellite's obviously greater angular velocity across the sky over that of the moon.

If you would like to estimate what it would take to communicate via the satellite, the charts given below will enable you to do so without becoming entangled in the astronomical numbers that crop up when using the Radar Range Equation directly. In the example given above for 1296 mc, the signal deficiency was shown to be 20 db. For different equipments and conditions, add or subtract the corrections shown on the chart to the 20 db deficiency. 73

1: **QST**, March, 1953.

2: **"Microwave Antenna Theory and Design"** by S. Silver, Radiation Lab. Series, McGraw Hill. Page 5.

3: **"Reference Data for Radio Engineers"** Fourth Edition, International Telephone and Telegraph Corp. Page 804.

Policies

Here are the basic policies which will guide 73.

Policy #1: We are not mad at anybody.

Policy #2: Amateur Radio, in its dual role as a means of arousing the interest of youngsters and providing the basic training for entry into the field of electronics, one of the largest and most promising fields we can see ahead, and as one of the most important means of communications between the peoples of the world on a people-to-people basis instead of through the press or government channels, is probably the most important hobby in the world today. We can keep it important by being aware of what is going on in our hobby and by being technically up to date. 73 Magazine is dedicated to bringing into focus the frontiers of amateur radio. It will strive to broaden the technical interest of the amateurs and to encourage them to higher technical attainments and abilities by means of technical and construction articles written by the best talent available.

Policy #3: Few talented writers have continued to buck the present system whereby they either receive nothing for their efforts or else have to wait from one to three years for minimal pay. 73 has established the policy of paying for all accepted articles with immediate cash. This seems to be bringing new life to the field for we are receiving top notch articles by some of the best authors in the hobby.

Policy #4: It is our intention, the SEC permitting, to open the ownership of Amateur Radio Publishing, Inc., to interested amateurs so that the ownership of the magazine can be widespread and the magazine will be truly owned and run entirely by licensed hams. 73 is being run under a very tight economy until the break-even point of 15,000 circulation is reached.

Policy #5: We intend to encourage and promote the publication of bulletins to bring specialized operating news of the many facets of amateur radio: VHF, RTTY, DX, Traffic Handling, TV, etc. The Club Bulletin of Marvin Lipton VE3DQX will be one of the first under this program. This publication, which is sent to the editors of all known ham club bulletins to provide them with a means of exchanging ideas, should be back in business this fall.

Improving the Signal to Noise Ratio of the

Gonset Communicator

. . . a simple modification for a remarkable improvement

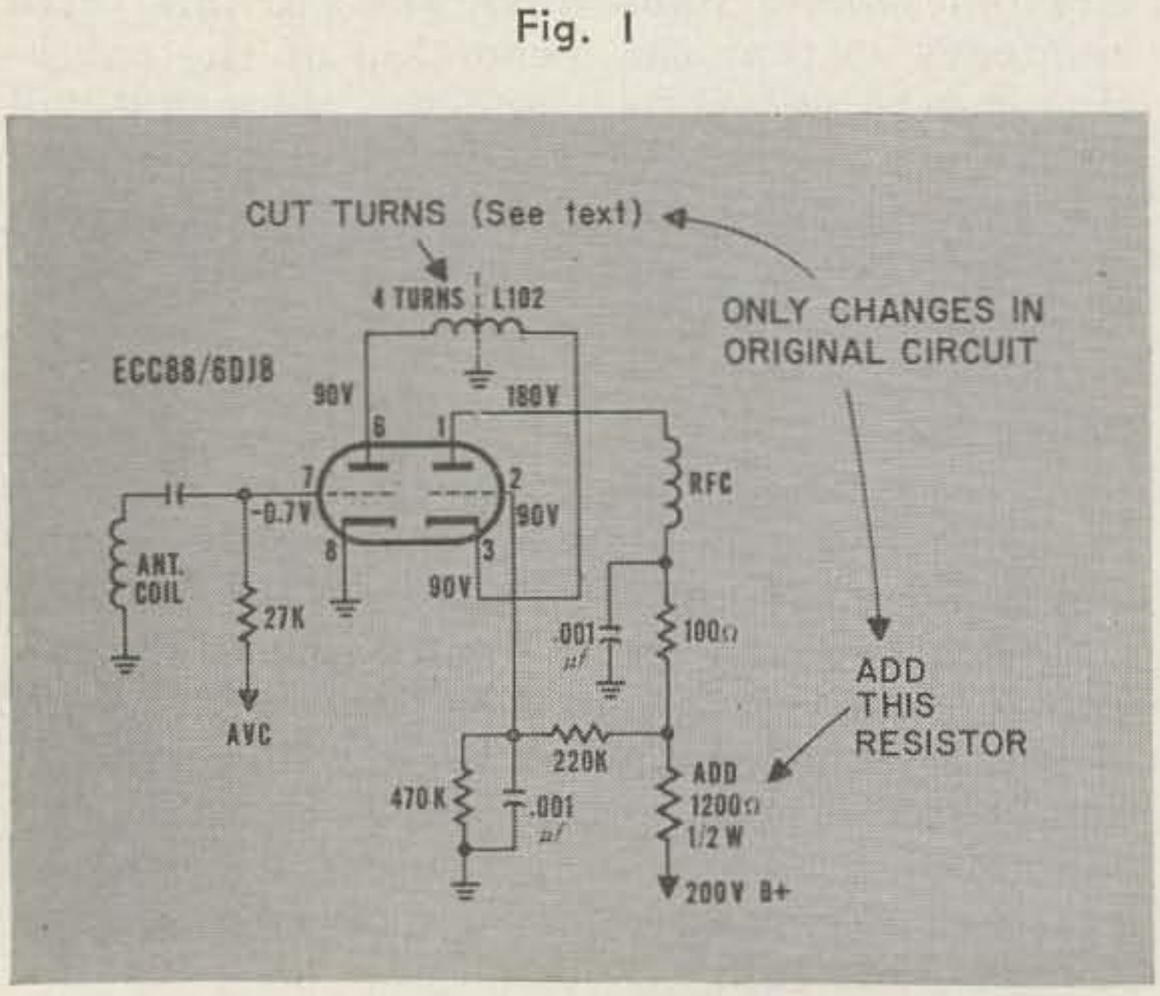
Bill Hamlin W1MCA
17 Post Gate Road
Hamilton, Massachusetts

THE Gonset Communicator is certainly one of the most versatile pieces of ham equipment ever mass produced. I've used mine just about everywhere and really enjoyed it. But, as probably happens to most engineers, the day comes when a professional look comes into the eye and some serious thought is given to hot-rodding it. This may be a natural phenomenon, or it may be a delayed result of reading about 417A converters and parametric amplifiers.

My Two Meter Communicator III was placed upon the operating table, disemboweled, and an autopsy performed on the front end. It became obvious that the designers knew what they were doing and that a major revision was not practical. There wasn't room inside for a parametric and it would be awkward to mount it outside, so I looked further. An easy way out came to mind: a better tube for the receiver's front end. The resulting improvement was beyond all expectations so I'm passing this along for the rest of you to try.

Since World War II, there has been an ever increasing pressure on tube designers for improvements because of the great and growing complexity of electronic equipment of all sorts and the competition of transistors. Tube designers have met this challenge and, even though there has been no real break-through in electron tube theory, there has been many startling new developments in design technology.

Fig. 1



RF Tubes

Better performance of rf amplifiers was brought about in recent years by miniaturization and improved electrode design by modification of prototype structures. The cascode circuit, such as in the Communicator III front end, employing two stages of triode amplification with a specially designed double triode tube seemed to be the culmination of engineering effort for garden variety equipment.

A good rf tube should have a high-gain bandwidth product and low noise which is a result of high transconductance, low interelectrode capacitances and low noise resistance. In tube design this means closer spacing of the grid to the cathode for higher transconductance and finer grid wires to hold capacitances and noise to low values. A practical limit is reached where the grid wires become so fine that they can no longer adequately support themselves

and the spacing is too close for reliable service without shorts.

One approach to the grid problem is to support the grid wires on a rigid frame, thus, the grid wires themselves do not have to support the structure. This is called a frame-grid tube (See Fig. 2). With this type of construction it is possible to cut the diameter of the grid wires to one half that of the conventional tube and also the grid may be moved closer to the cathode.

A New Tube for the Communicator

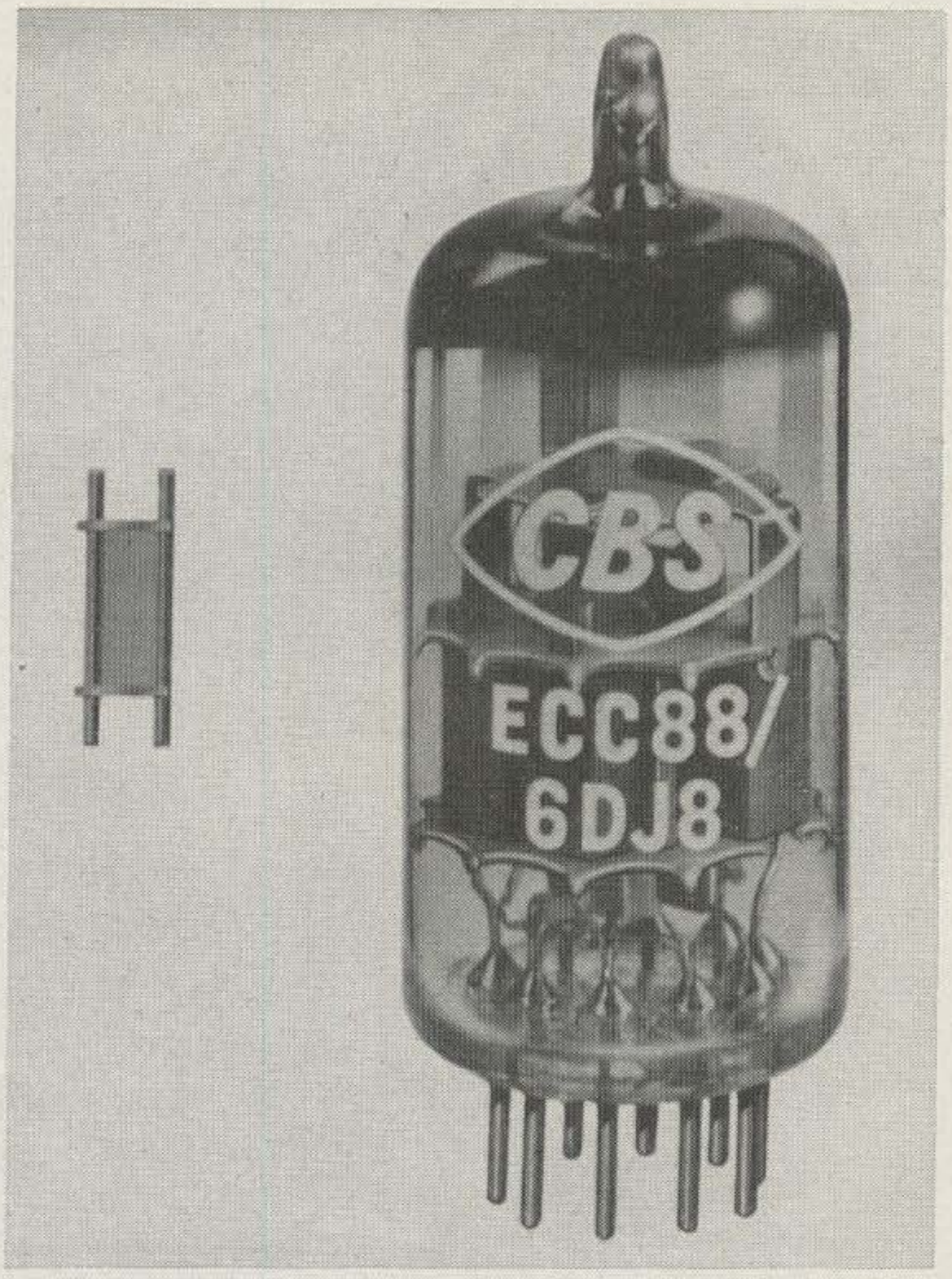
One of the frame-grid tubes that is now readily available is the CBS ECC88/6DJ8. It is a double triode designed for cascode amplifier service. It will replace many conventional American tubes in this class of operation and provide superior performance.

The ESS88/6DJ8 is tailor made to improve performance of the Communicator III front end. It has a transconductance of 12,500 μmhos in typical operation with 90 volts applied, while the 6BZ8 originally used in the Communicator III has a transconductance of only 8,000 μmhos with a plate voltage of 125 volts. The lower plate voltage of the ECC88 indicates lower noise output. In comparison, if the voltage of the 6BZ8 were lowered to 90 volts to reduce noise its transconductance would drop down to about 6500 μmhos. In addition, the ECC88's frame-grid structure with its finer grid wires reduces electron shot noise caused by the random impact of electrons against the grid wires.

To see what adjustments were necessary for substitution, when the characteristics of the ECC88/6DJ8 were compared to those of the 6BZ8 it showed that only the plate voltage had to be adjusted to obtain proper operating conditions. In other words, shifting the plate to a lower voltage brought all other parameters in line so that the grid biases were properly Class A without further adjustment. (Type 6BZ8 operates at Class A with 125v plate, —1.0 volts grid, and 10 ma plate current. Type ECC88 operates with 90 volts plate, —1.3 volts grid, and 15 ma plate current.)

Reducing the voltage of each section of the tube was simply accomplished by inserting one series resistor of 1200 ohms into the B plus power lead. This takes care of both sections of the tube as they are in series in the cascode circuit (See Fig. 1).

One unexpected difficulty arose in that instability and oscillations occurred in several places of the band. This was due to the slightly higher capacity of the ECC88/6DJ8. The resonant frequency of the plate to cathode connected neutralizing coil (L102) with the internal tube capacitances must be lower than the receiver frequency. The instable condition was easily rectified by reducing the size of



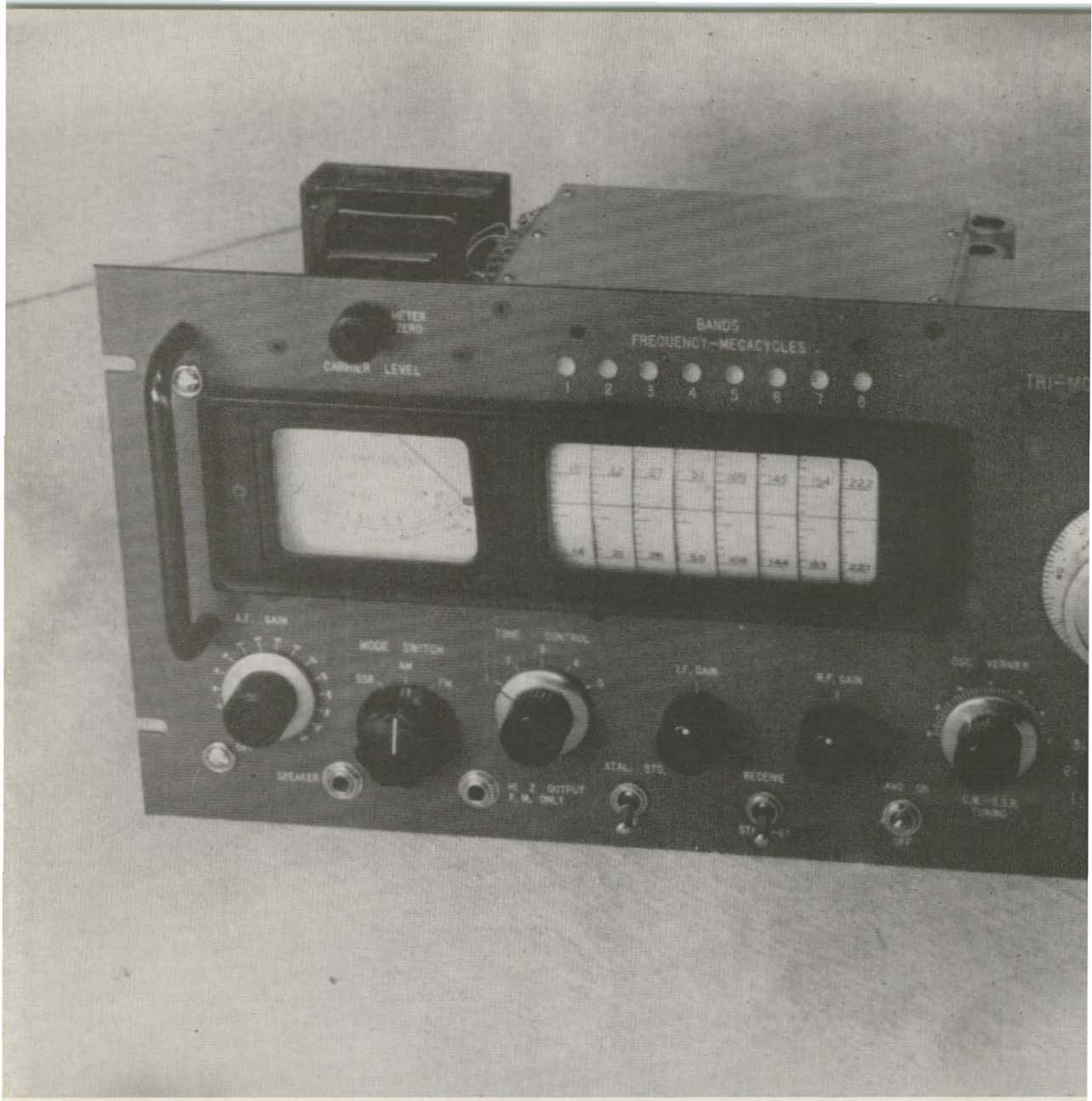
The ECC88/6DJ8 high-gain twin triode with true frame-grid construction is now available from CBS Electronics, manufacturing division of Columbia Broadcasting System, Inc. The grid itself is shown to the left of the tube.

coil L102 to about one half of its original size. L102 can be located going through the shield between tube socket pins 3 and 6. Either wind a new coil of 4-turns and ¼ inch diameter or cut the original L102. Further adjustment may be necessary by stretching the shape of the coil until no spurious oscillations are detected when tuning over the entire 2-meter band.

After these changes are made and the Communicator reassembled, the interstage rf transformer should be peaked with the rf trimmers accessible through the two front holes in the bottom of the case.

The noise level with the new tube is so much lower than originally that it may be a little difficult to tune to maximum on the noise level. If a noise generator is not available, then an incoming signal may be used, preferable a steady low level signal. It should be unnecessary to touch the input stage as it is an untuned-broadband circuit that is effected very little by slight differences in input capacity between the original tube and the new tube.

The completed conversion is so good from the noise stand point that most of the remaining noise is generated in the converter stage. It would now be appropriate to work out a reduction of noise in this area. 73



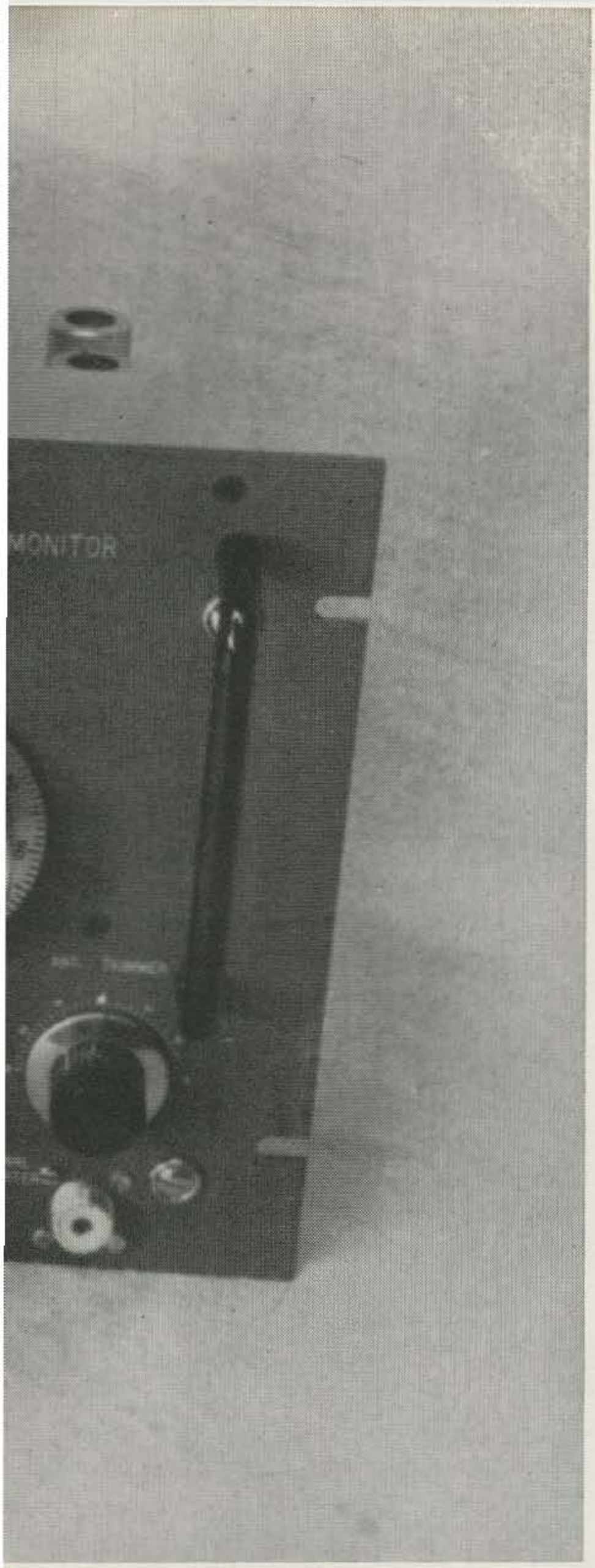
Pictures processed by Joe Kwetnewski W9UTD.

ONE phase of our stimulating hobby that new amateurs and a good majority of old timers shy away from, is the building of receivers. They see them as an octopus or as something more frightening and shield themselves behind the old phrase, "It's cheaper to buy, so why rack your brain?"

This statement only holds water in cases where each and every item of the planned project necessitates fabrication by other craftsmen besides yourself, so even if you get a bargain on construction, costs will mount up to a prohibitive figure. But if man or boy leans toward such past-time, bird watching would be more advantageous than the choice of radio as a hobby.

It's surprising to learn that a receiver is no more difficult to design and construct than is a transmitter or any other electronic device if it's broken down into sections. It does look complicated if you take a peak at the underside of it and see the wiring and the many associated components; but so does a transmitter if you just glimpse at the bottom of it. However, if you separate each tube and their components into stages and just examine each stage in succession, all the mystery vanishes rapidly.

The receiver herewith described required a lot of planning, numerous changes and some borrowed tools before the completed unit was buttoned up as a finished project, but believe



Tri–Mode VHF Monitor

John Wonsowicz W9DUT
4227 N. Oriole Avenue
Norridge 34, Illinois

me, it was a challenge and fun immensly enjoyed, for there is nothing that will give you more self satisfaction than self expression in your chosen art.

Actually this receiver was planned and built around the xtal controlled converters described in the October issue of "73" and it is used as a double conversion tunable *if* that tunes 13 to 18 mc. The sensitivity of this *if* is better than .1 microvolt on AM, stabilization time is about 10 minutes, and band width less than 3 kc at 3 db down on AM and SSB and 150 kc on FM.

Reception of all modes of signals is possible and all necessary controls are provided within easy reach and are . . . RF and IF Gain Control, Antenna Trimmer, Osc. Vernier, Tone Control, AVC Switch, Hi-Z Output, External Converter Output, etc. It has an illuminated S-meter calibrated in S-units and micro-volts at the antenna input and an accurately calibrated large drum dial which is back-lash proof.

The panel with all nomenclature engraved is 8¾x19″ standard aluminum gray crackle finish that can be rack mounted.

The drum dial which is machined from a solid piece of aluminum has eight bands of calibrated scales, and above this drum are eight ¼″ lucite plugs inserted into the panel with numbers from 1 to 8 engraved in the panel below them to designate the band in use. These lucite plugs are illuminated by the same

Schematic diagram

ALL COILS ARE CTC PLS5/B $1\frac{1}{16}$" x $\frac{3}{8}$" CERAMIC SLUG TUNED

ANTENNA COIL

L1-12 TURNS #26 ENAMEL, CLOSE WOUND.
(LO Z ANTENNA WINDING - 4 TURNS #26 PLASTIC WIRE AT COLD END)

R.F. PLATE COIL.

L2-30 TURNS #26 ENAMEL, CLOSE WOUND.

MIXER COIL

L3-24 TURNS #26 ENAMEL, CLOSE WOUND.

H.F. OSC. COIL

L4-21 TURNS #26 ENAMEL, CLOSE WOUND.
(TAP 7 TURNS FROM COLD END)

R.F. COILS FOR TRI-MODE MONITOR

(TO MATCH MODIFIED CAPACITOR)

R.F. SEC.

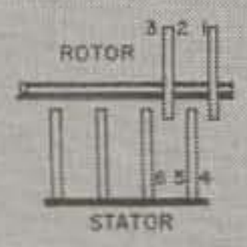
1 ROTOR - 24 mmf MAX (4 SIDES)

MIXER SEC.

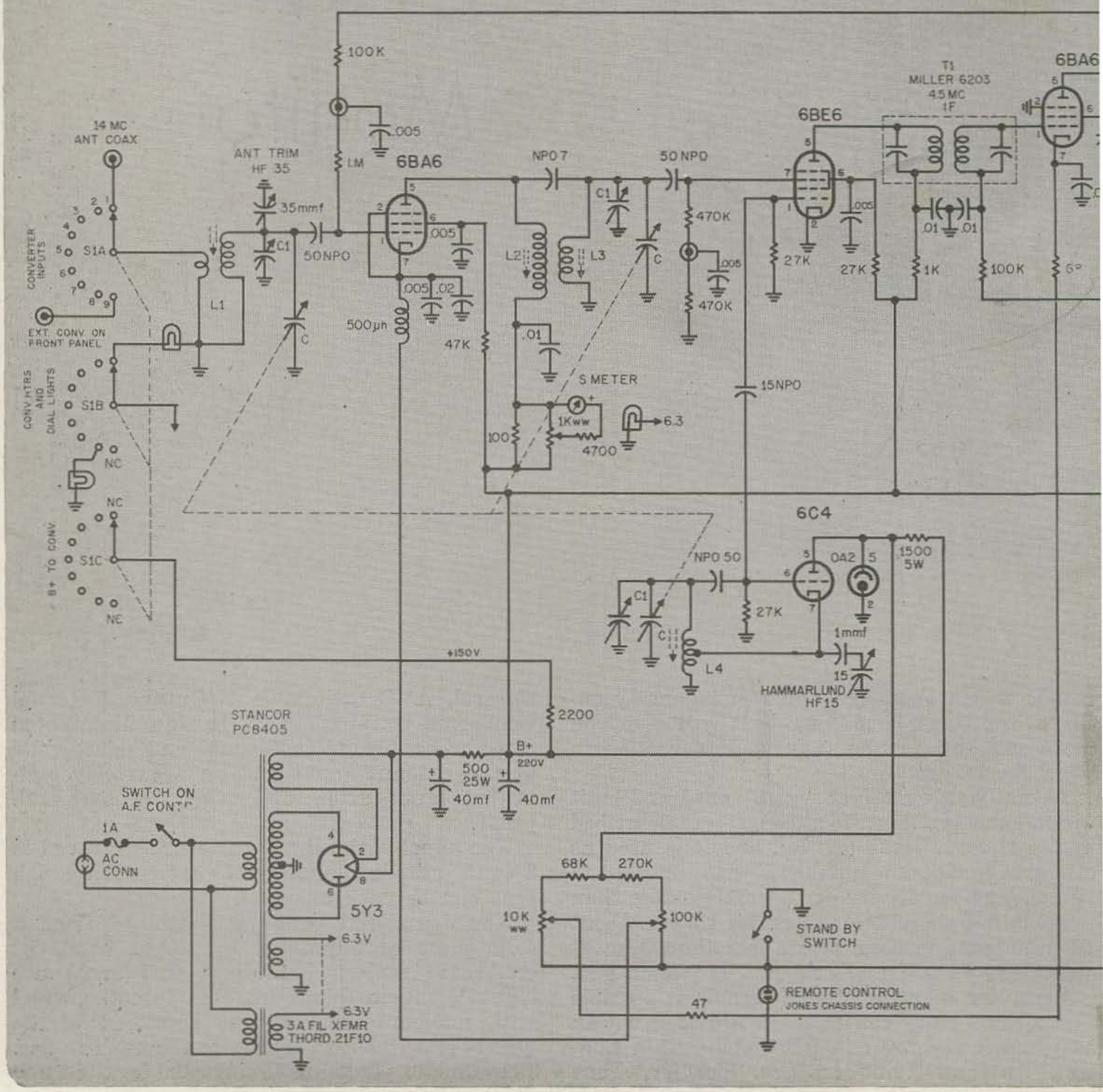
1 ROTOR - 24 mmf MAX (4 SIDES)

OSC. SEC.

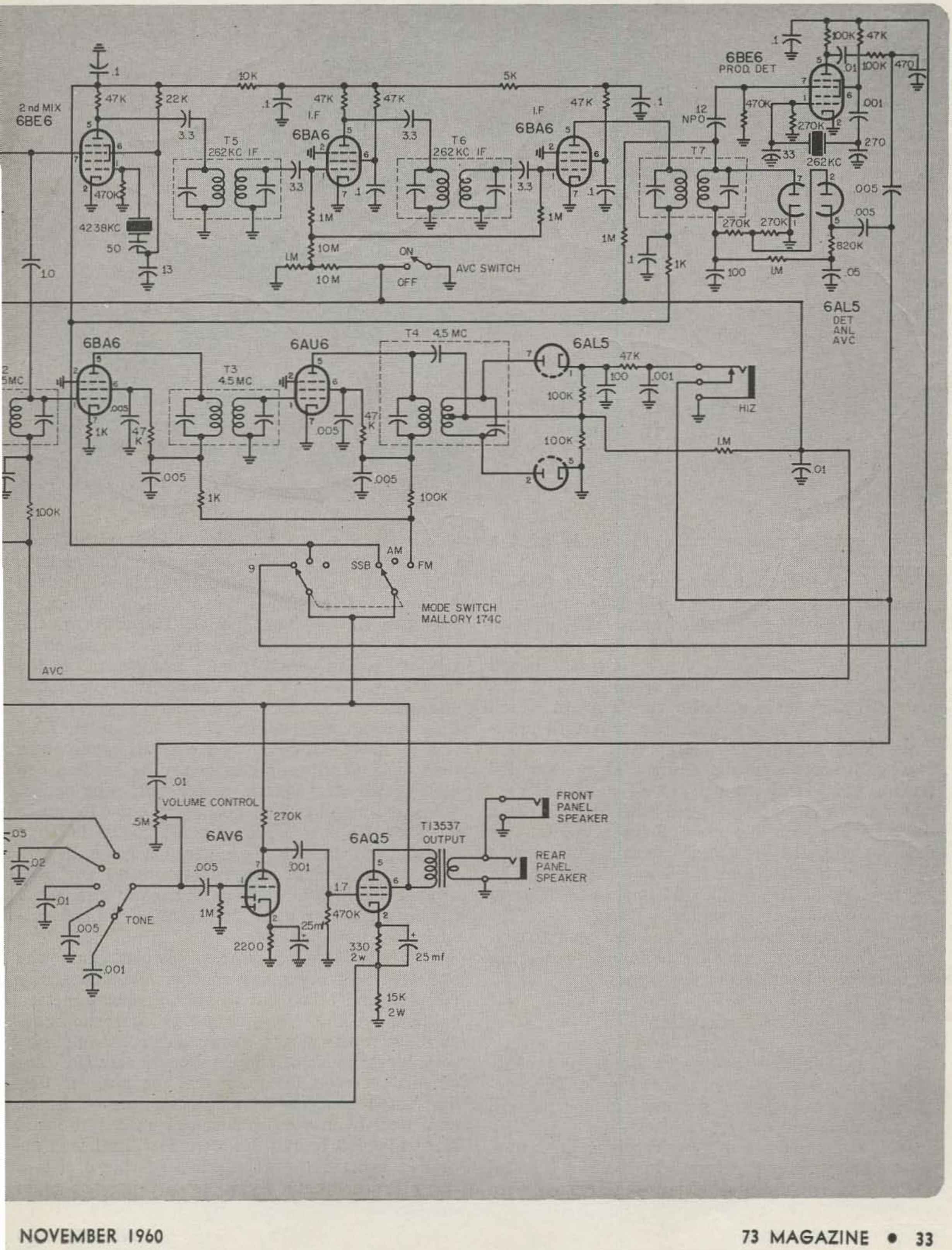
2 ROTORS AT ONE END OF CAP.
MAKING (6 SIDES) MAX C = 22 mmf.

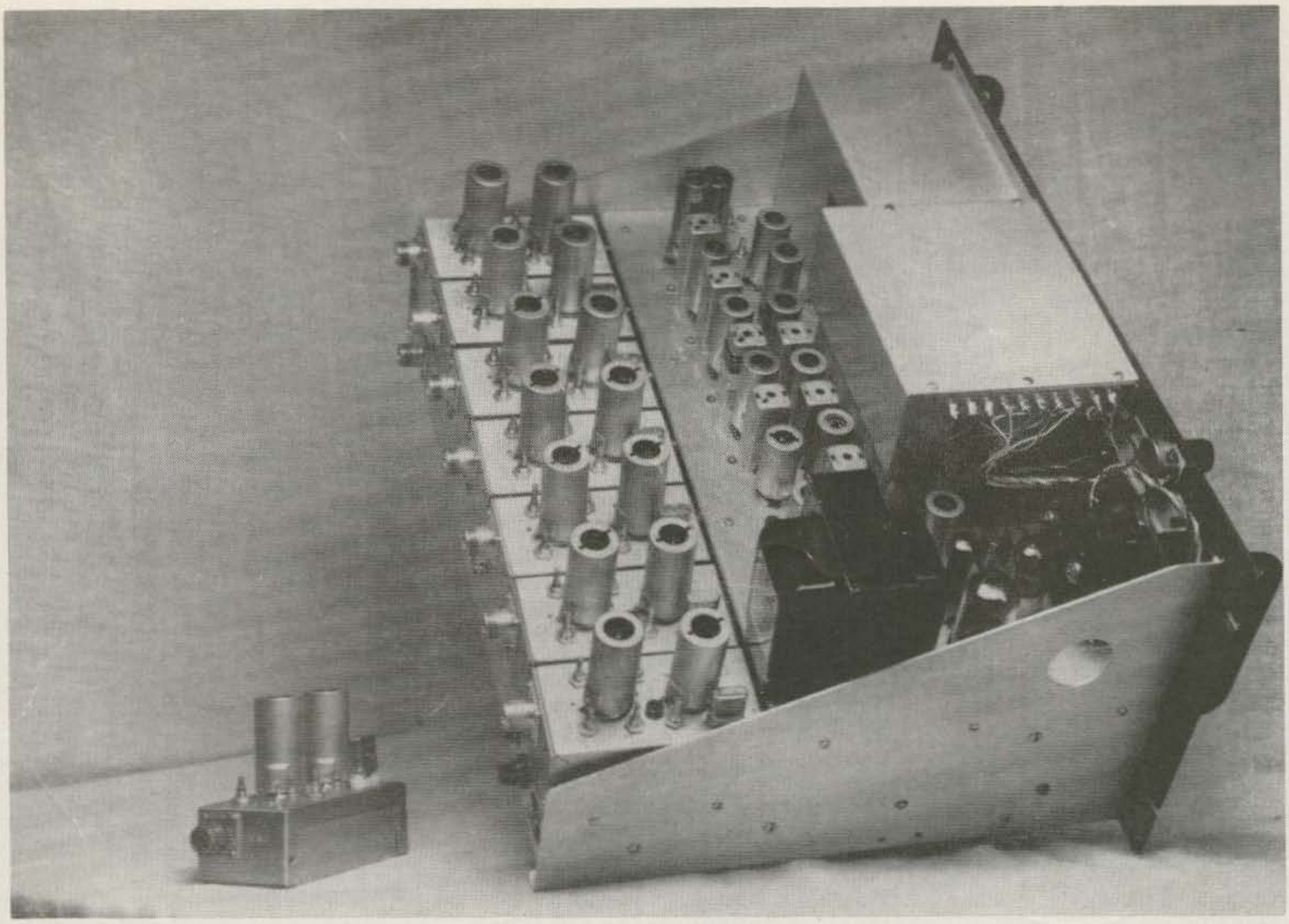


C - MODIFIED TUNING CAPACITOR
C1 - AIR TRIMMERS 10mmf
S1-A,B,C - MALLORY 180C
3 GANG, 3 POLE, 11 POSITION.
T1, T2, T3, - (J.W. MILLER) 6203
T4 - (J.W. MILLER) 6204 DISC.
T5, T6, T7 - (J.W. MILLER) 12-HI



-Mode V.H.F. Monitor





pilot lights that illuminate the scale of the band in use.

The signal strength meter which is a 0 to 50 micro-amp wide view 3½" Simpson meter, is mounted upside down so that it will indicate from left to right. This meter has a hand calibrated scale made of heavy bristol board cemented to the back of the original scale, and above the meter is a meter zero control which is handy for giving true signal strength readings using zero noise reference.

The S-meter and the drum dial are framed by an escutcheon milled out of a 3"x11"x½" aluminum plate and sprayed with black crackle enamel to match the rest of the trim. In this frame a piece of ⅛" plexiglass is mounted with a fine line scribed and filled with India ink in the section of the drum dial only, and is used as a hair line for the scales.

Black handles were provided for ease of carrying the receiver, also as means of protecting the dial and knobs from damage.

Construction

It is established that no two persons will do the same job alike, therefore, just a light description covering the mechanical details will be outlined, and are as follows:

The main chassis of this receiver is shaped on a brake generally found in the sheet metal shops and is $\frac{1}{16}$" thick aluminum formed with a ledge 1½" deep and 4½" wide on the back end of the chassis to house the seven converters. The front part of this chassis is 3½" deep with a ½" lip turned down so that it can be fastened to the front panel. The sides of the chassis also have ½" lips and are fastened to the side plates which in turn are secured to the front panel and serve as brackets. The finished chassis, as shown in the photograph, is 17" long and overall width of 13" of which 8½" is 3½" deep. All cut-outs are easily made since that type of chassis can easily be held in the vise. After the chassis is formed, tube socket holes are punched and necessary cut-outs made with a hack saw blade or a nibling tool. Upon completion, the chassis is given a lye bath and sprayed with clear acrylic (top only) for neat appearance. The dust covers over the main tuning capacitor and drum dial are also treated in the same manner.

The face of the receiver, which constitutes the panel and all necessary controls, was carefully planned and layed out so that proper function controls are at the finger-tips and the associated circuits nicely grouped for ease of wiring. While most of the components on the face of this receiver are standard, the main tuning dial knob that drives the capacitor with the attached drum was turned out on a lathe and a standard 0 to 100 division 2¾" dial was attached to it. Behind the panel of this dial is a large brass inertia fly wheel driving the main

tuning capacitor. Fast excursion from one end of the band to the other is possible by giving the dial a few spins.

The drum used as the frequency dial is machined from solid stock and is 5″ in diameter and 5″ long. It is secured to the end of the main tuning capacitor by a 5/16″ coupling which is fastened to the 5/16″ drill-rod shaft running through the drum. The drum has 2 parallel grooves and clamps to fit, so that a plastic or paper scale can easily be secured. Those that wish to duplicate the appearance of this receiver can substitute a cardboard tube or a tin coffee can for the machined drum with slight modifications.

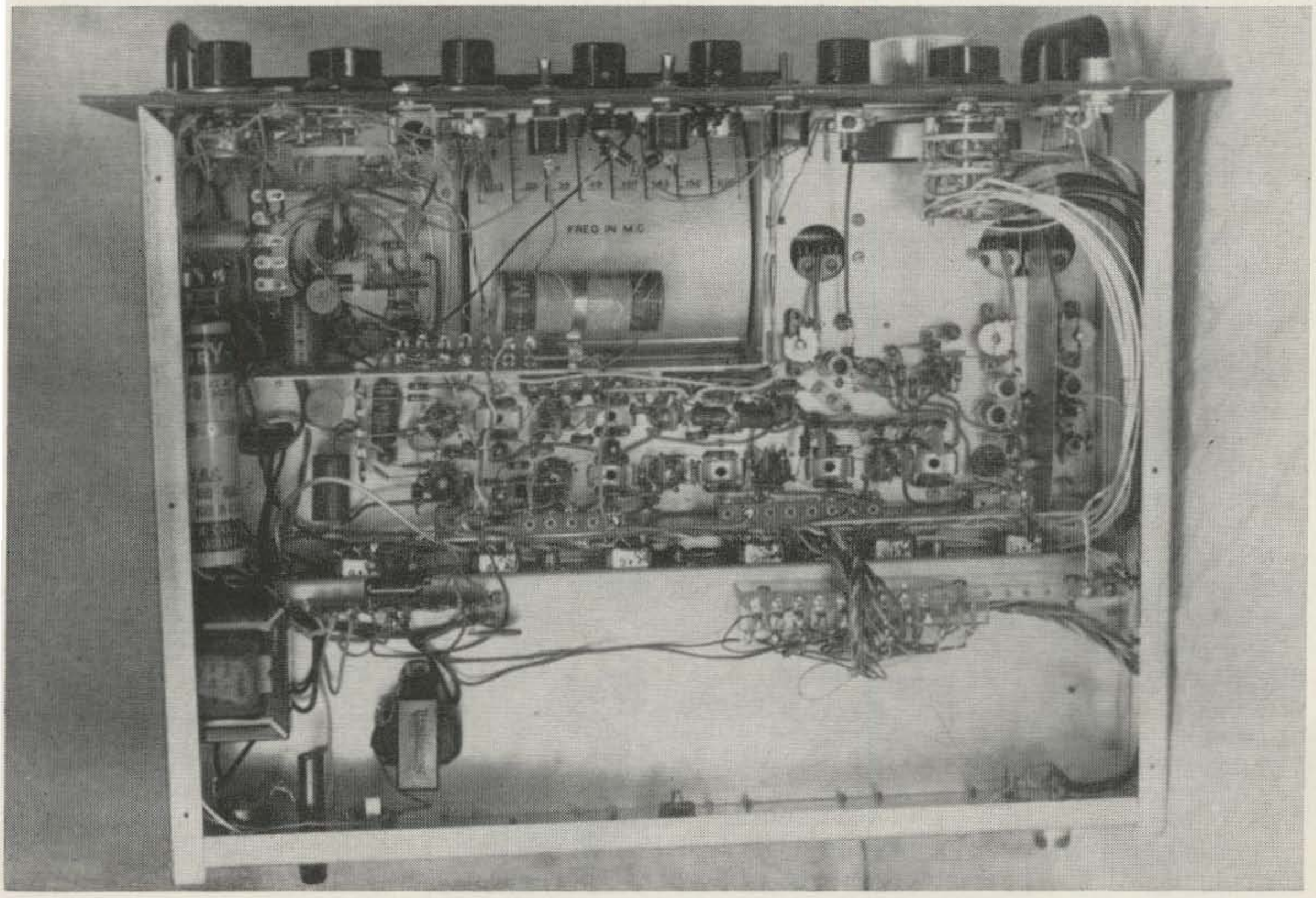
The heart of the receiver is, as usual, a good rugged tuning capacitor. This one was found in a surplus store and modified to cover the 5 mc tuning range. The only information available on this capacitor is the two numbers ink stamped, D-227464-2 and W504. The description is as follows: Three gang with right angle worm drive. A narrow drum dial about ½″ wide divided into 30 divisions is mounted between the wide spaced section and the adjacent close space sections. The first close spaced section has 7 rotor and 7 stator plates, the second close space section has 6 rotor and 5 stator plates and the third section, which is double spaced, has 7 rotor and 6 stator plates. The original maximum capacities were as follows: 1st section 152 mmfd, 2nd section 115 mmfd and the double spaced section which is used as the HF oscillator tuning had 88 mmfd.

After modification, which was removing rotor plates only, the maximum capacities are as follows: First and second section 24 mmfd and osc. section 22 mmfd. This capacitor has no stop and none was provided so that continuous tuning can be achieved. The worm drive mechanism was tried for back-lash, but no noticeable effects were evident through the nicely matched and spring loaded gears.

In the event that this capacitor cannot be found, I would suggest that any three gang rugged capacitor be used by stripping rotor plates (those are easier to take off) and reducing the max. tuning capacity to around 25 mmfd. Ordinarily only 1 rotor plate will be used to get the desired 25 mmfd range. Another alternative is to use three Hammarlund MC-35S capacitors, couple them together with solid brass couplings and use a Millen No. 10012 right angle drive with a plannetary drive dial or a reduction drive mechanism Millen type 10000.

Circuits

The 6BA6 rf stage, besides being an amplifier, also doubles as a signal strength indicator by inserting a properly shunted microammeter or milliameter in the cold end of the rf coil L2 as shown in the schematic. This



stage is provided with the usual variable cathode bias to control the rf gain and has AVC applied to its grid.

The antenna trimmer capacitor which is a 35 mmfd variable is in shunt with the first section of the main tuning capacitor used to tune the grid of this stage and does a fine job of peaking.

The plate circuit is inductively coupled by L2 to L3 the signal grid of the 6BE6 first mixer. A small amount of capacity had to be added for tighter coupling due to the spacing of these coils which are independent of each other and spaced ½" on center. This is also shown in the schematic.

Test points were provided in both stages as a better means of metering during alignment of the circuits.

The tunable **oscillator** is a Hartley, using a 6C4 triode; its plate returning directly to the VR-150 regulator. No negative co-efficient capacitors were used for stabilizing since the settling time is very short due to the air trimmers, ceramic coil forms and NPO ceramic capacitors used in all rf circuits. A 15 mmfd tuning capacitor in series with a 1 mmfd ceramic is added from cathode of the oscillator to ground for fine tuning in the SSB and CW mode. A small dial is provided for it on the front panel and it is engraved "Oscillator Vernier."

The first **mixer** is a standard mixer circuit employing a 6BE6 pentagrid converter tube with a separate oscillator. The grid coil L3 in this circuit has a ceramic form and the 50 mmfd grid coupling capacitor is a ceramic NPO.

The output of the first 6BE6 mixer is fed through two stages of 4.5 mc, *if* using 6BA6 as amplifiers. The cathode of the first *if* stage is brought to a *if* gain control on the front panel, and its grid circuit tied to the AVC bus. The output of the second stage ties into the 6AU6 limiter stage; this in turn drives a 6AL5 discriminator. Negative voltage developed at the junction of the 100K resistors is fed back to the AVC line through a 1 meg isolation resistor. AVC switch is provided on the front panel to ground the AVC bus.

The output of the discriminator passes through a RC filter to a closed circuit phone jack on the front panel for HI-FI take off on FM only. This jack is engraved "HI-Z Output". From this jack audio voltage is fed to a two stage audio amplifier consisting of a 6AV6 triode section and a 6AQ5 power amplifier.

At the grid of the second 4.5 mc *if* amplifier a signal take-off through a 10 mmfd NPO capacitor is fed to the signal grid of the second 6BE6 **mixer.** This mixer uses a self contained crystal oscillator operating on a freq. of 4238 kc and converting the 4.5 mc signal to the low freq. *if* of 262 kc.

Two **low frequency** 262 kc *if* stages are used for amplification. These stages are very low noise devises due to their circuitry. As shown on the schematic, the cathodes are grounded and the plate and screen circuits operate at relatively low voltages. You will also notice that the plate and grid circuits are shunt connected and are coupled to their respective *if* transformers by 3.3 mmfd NPO ceramic capacitors.

This system proved to be very effective in reducing the noise to the minimum and not effecting the over-all amplification of the signal. The secondary of the last transformer is connected to a 6AL5 which is used as the second detector, AVC rectifier and a very simple but effective noise limiter. Here is another nice feature that readers might enjoy: the absence of ANL switch. In most cases known to the author, such a switch is always in the "on" position. By choosing the proper time constant values in the ANL circuit for a compromise of audio quality and clipping the switch was eliminated.

At the secondary of the last 262 kc *if* transformer a signal take-off through a 12 mmfd NPO ceramic capacitor is fed to the signal grid of another 6BE6 converter which is used as a product detector for SSB and a CW mixer. The ordinary tunable BFO was replaced by a crystal oscillator of 262 kc which has the advantage of stability. This feature is desirable in SSB tuning since the only drift possible is in the hf tunable oscillator, and that has been taken care of as mentioned earlier in the article.

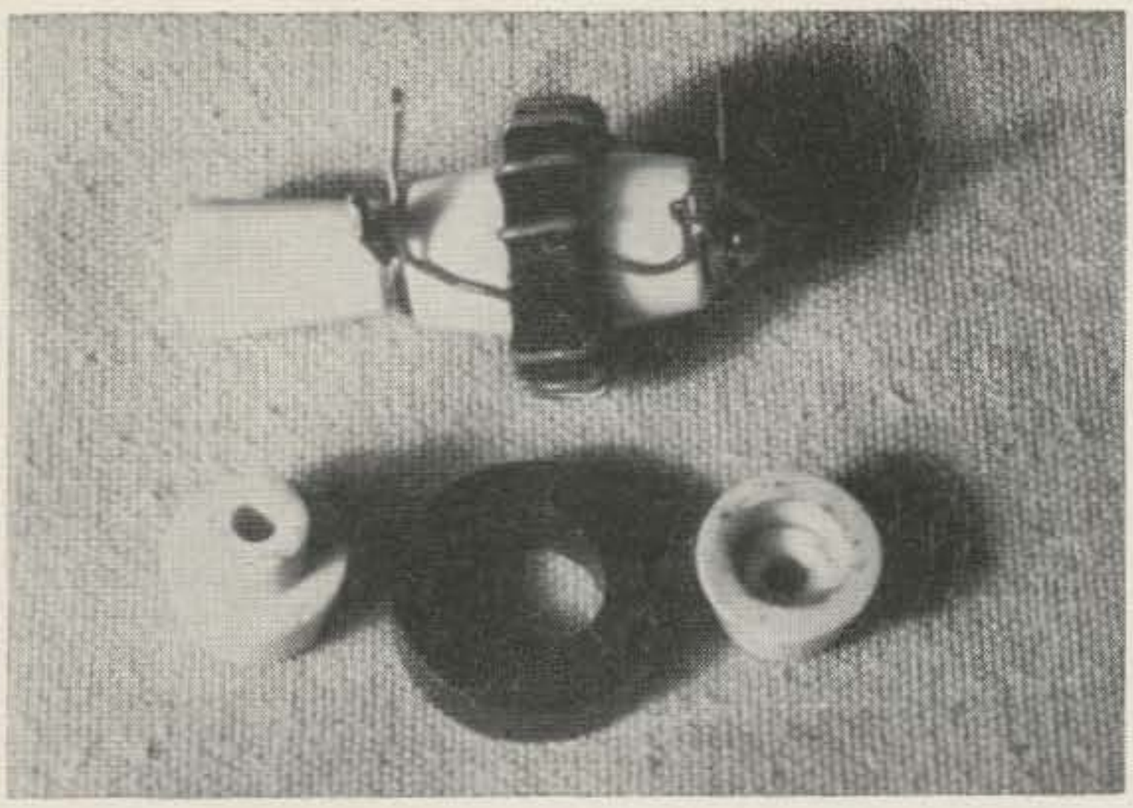
The audio from the product detector is taken off the plate through a RC filter and tied in with the AM second detector and the FM discriminator as shown on the schematics. This audio voltage is capacitively fed into the .5 meg volume control which ties also to a 5 position tone switch used for high frequency attenuation.

The output of the power amplifier transformer is coupled to two speaker phone jacks, one on the front panel and the other on the back of the chassis. The front jack is used to try out different speakers, and such an arrangement is quite handy at times.

The mode switch applies the B+ to the particular circuit in use and no unnecessary loops or feed back was encountered in this type of simple switching.

The power supply is standard full wave rectifier, well filtered producing 220 volts at 120 ma. An additional 6.3 V at 3 amp heater transformer was added to take care of the additional illumination and converters. An OA2 regulator tube supplies voltage to hf tunable oscillator and the bias for rf and *if* circuits.

In conclusion, a word about tuning might be in order. A very pronounced feature is evident during excursions of the tuning dial between signals. With the audio control set at mid point very little noise is heard in the speaker, then brace yourself when you tune across a signal. 73



Toroid Coils

Roy E. Pafenberg
P.O. Box 844
Fort Clayton, Canal Zone

Photo taken by Jim Gardner

THE USE of toroidal inductances, wound on ferrite cores, is becoming increasingly popular in critical applications where the characteristics of stability, high Q, high inductance to space ratio, low external field, lack of proximity effects and the ease of obtaining balance in tightly coupled multi-winding units are desirable. Probably the most common commercial use is in the broad band input transformer found in many TV tuners.

The ferrite core, toroidal inductor is a natural for amateur VFO use. The high Q required for such circuits as the Clapp oscillator is easily obtained in compact assemblies and, dependent on the mounting arrangement, these inductors can be made almost immune to vibration effects. Such an application is described in detail in the article, **Automatic Tracking Mobile System,** by Henry S. Keen, published in the October, 1958 issue of *Radio and Television News.*

There are many references in amateur literature regarding the use of toroid coupling transformers in high frequency crystal filters. The tight coupling that is obtainable and the degree of balance that may be achieved by the use of bifilar winding techniques ideally suit them to this application. Arnold and Allen in their article, **Some New Ideas in a Ham-Band Receiver,** published in the May, 1960 issue of *QST,* discuss the subject and point out a ready source of the high frequency toroid coil forms. As a point of interest, the use of ferrite core toroidal transformers is not limited to minute power levels. The Technical Material Corporation is using these cores in a 500 watt balun, designed to match a 50-70 ohm transmitter output to a 600 ohm balanced transmission line.

One characteristic of ferrite cored inductors that may be put to good use is that the permeability of the core, and thus the winding inductance, may be changed by flowing a modulating signal or an adjustable dc bias current through either the signal winding or a special winding added for that purpose. This technique was employed in the Ferri-Sweeper, a sweep frequency signal generator designed for the alignment of SSB filters. This instrument was originally described in the old CQ *SSB Handbook* and was expanded on in an article by Wilfred M. Scherer, W2AEF, in the November, 1957 issue of *CQ.* The concept of dc tuning, applied to the resonating of radio frequency circuits, offers unlimited possibilities. It is easy to visualize a complete multiband transmitter or communications receiver gang tuned by a single potentiometer which would vary the magnetic bias of the ferrite core inductors. This intriguing concept is described by Kulinyi, Levine and Meyer, in their article, **SSB in High Frequency Vehicular Radio,** which was published in the famous "Sideband" issue (December, 1956) of *Proceedings of the IRE.*

The advantages gained by the use of the new ferrite cores are not completely without cost. Available core materials are more or less temperature sensitive and compensation is required for critical, frequency determining applications. The techniques used in conventional circuitry are effective in the case of the ferrite cores and will not be detailed here. While the windings of a ferrite core, toroidal inductor are relatively immune to external electrostatic and electromagnetic fields, this is not true of the core proper. Care must be exercised in the placement of these inductors in relation to strong magnetic fields and critical circuits should be magnetically shielded. This requirement is easily met by the use of commercial, plated steel chassis.

One problem in the use of these inductors is the difficulty of mounting them in conformity with good construction practice. The photograph shows one method of assembling a neat, workmanlike, electrically stable and mechanically sound mounting. As shown, the mounting consists of a ceramic feed-through insulator, the center bushing of which fits snugly within the center of the wound inductor. This assembly is, in turn, secured to a small ceramic post insulator with a brass screw. The top coil terminal lug is electrically connected to the screw, while the bottom lug is insulated from the screw by the use of shoulder type fiber washers inserted between the bottom half of the feed-through insulator and the ceramic post. Use of the fiber cushion washers supplied

(Continued on page 56)

A Five-Dollar Frequency Meter

Jim Kyle K5JKX/6
1851 Stanford Ave.
Santa Susana, Calif.

WANT to measure frequency down to the last cycle per second? Or maybe find the exact resonance point of that AF filter you've just whipped together?

Here's a gadget that can help you do either of those, and more besides. RTTYers will find it handy for checking frequency shift. Experimenters can use it for measuring drift in a VFO. And you will find many uses for it, too, around your own shack.

It's an audio frequency meter, costing approximately five dollars if all parts are purchased new and taking only about an hour to put together (less time than that if you're used to homebrew techniques).

While many AF frequency meters have been described in previous articles, none have all the advantages of this pocket-sized unit. Designed around the peculiar properties of most transistors, it uses only nine components (aside from range-switching circuitry), is rugged, and features high accuracy.

Before getting into the construction of the little gem, let's take a look at how it works.

The basic principles of the direct-reading audio frequency meter have been with us for at least 15 years (see the references). However, the limitations of vacuum tubes and later of vacuum-tube-directed design techniques have kept the beastie complicated enough to prevent many hams from building it.

The block diagram in Fig. 1, adapted from Terman's *Electronic and Radio Engineering*, shows the conventional circuit. Diodes D1 and D2 limit the signal to a definite peak value. Capacitor C1 differentiates the limited signal into positive- and negative-going spikes. Diode D3 shunts the negative-going spikes around the meter circuit, while D4 allows the positive-going spikes to pass through the meter. The deflection of the meter is directly proportional to the number of spikes which pass through it within a given time.

As shown, the circuit is simple enough. However, the usual input signal is small—and this circuit requires spikes some 45 volts high to give an accurate indication.

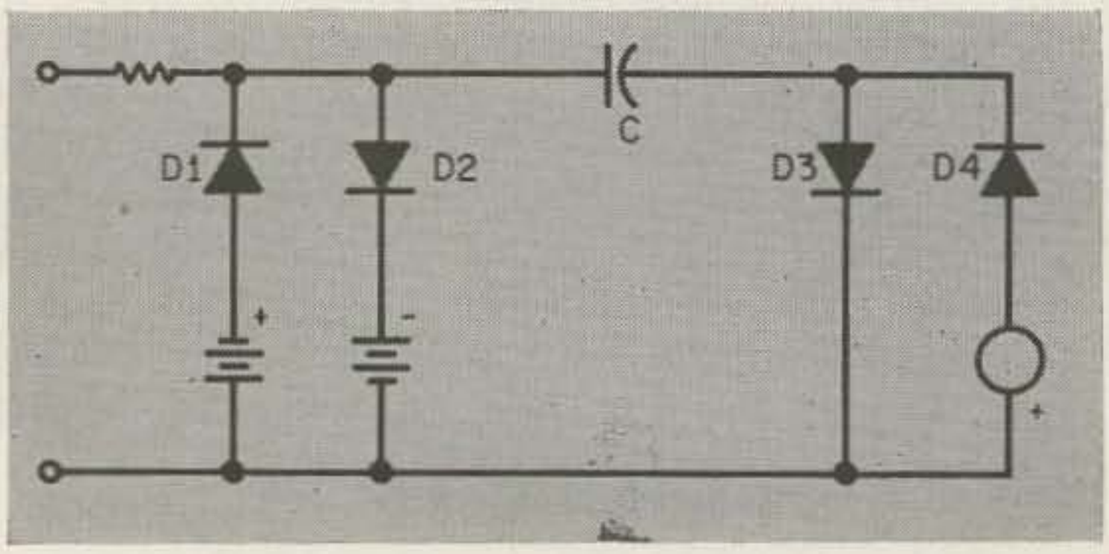
Previous designs have solved the problem by first amplifying the signal, then passing it through a limiter stage, and finally differentiating and measuring it. See any of the construction references for further details.

The five-buck special, on the other hand, uses the switching properties of transistors to accomplish the same purpose.

Looking at the schematic diagram, Fig. 2, you will see that input signals go directly to the base of Q1 through the 470-ohm current limiting resistor. Normally, since the base is not forward-biased, Q1 is cut off and passes little or no current. As a result, there is no voltage drop in the 5600-ohm collector resistor and the voltage at the collector is -9 volts.

When the negative half-cycle of an input signal comes along, however, the picture changes. The negative input places forward bias on the base, and when this bias becomes large enough, the transistor switches to saturation. Resistance from collector to emitter becomes less than one ohm, and the entire

Fig. 1—Simplified Diagram



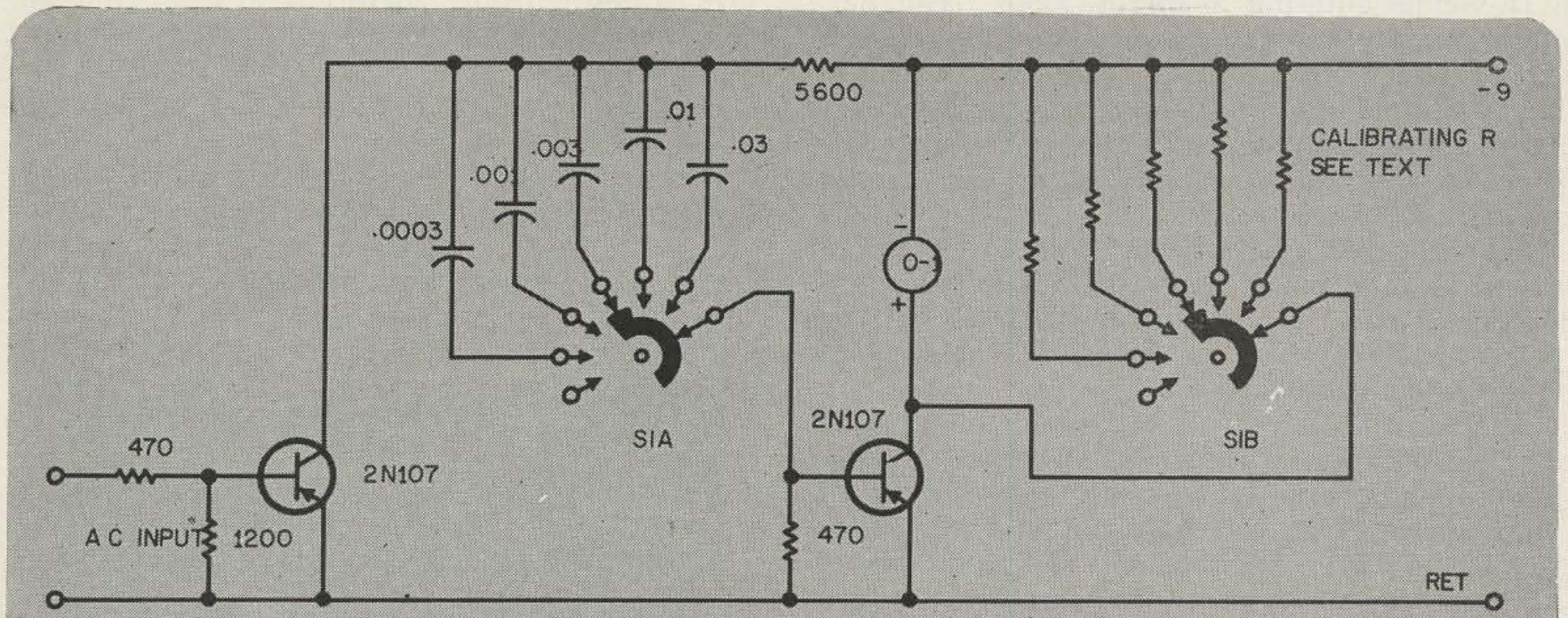


Fig. 2—This is the diagram of the deluxe model. For the five-dollar special, omit all switches and components associated with them. Connect a capacitor of proper value in place of SIA. Ranges are: OFF, 30 KC, 10 KC, 3 KC, 1 KC, and 300 CPS. Meter is 0-1 ma.

supply voltage is dropped in the collector resistor. Collector voltage drops to zero.

Approximately 0.2 volts is the crossover point for the 2N107 used in this circuit. This makes 200 millivolts the smallest signal which can be measured. Upper limit is determined by punchthrough voltage rating, and is about 10 volts for this unit.

We have seen how a square wave is developed at the collector of Q1 from a sine-wave input. Now let's look at the rest of the circuit.

Capacitor C, the timing-reference unit, differentiates the square wave into spikes exactly as in previous circuits. These spikes are applied directly to the base of Q2.

Q2 also acts as a switch. Positive-going spikes simply reverse-bias the base and have no effect on the collector circuit. However, negative-going spikes turn the transistor "on" for the duration of the spike and allow pulses of current to flow through the meter.

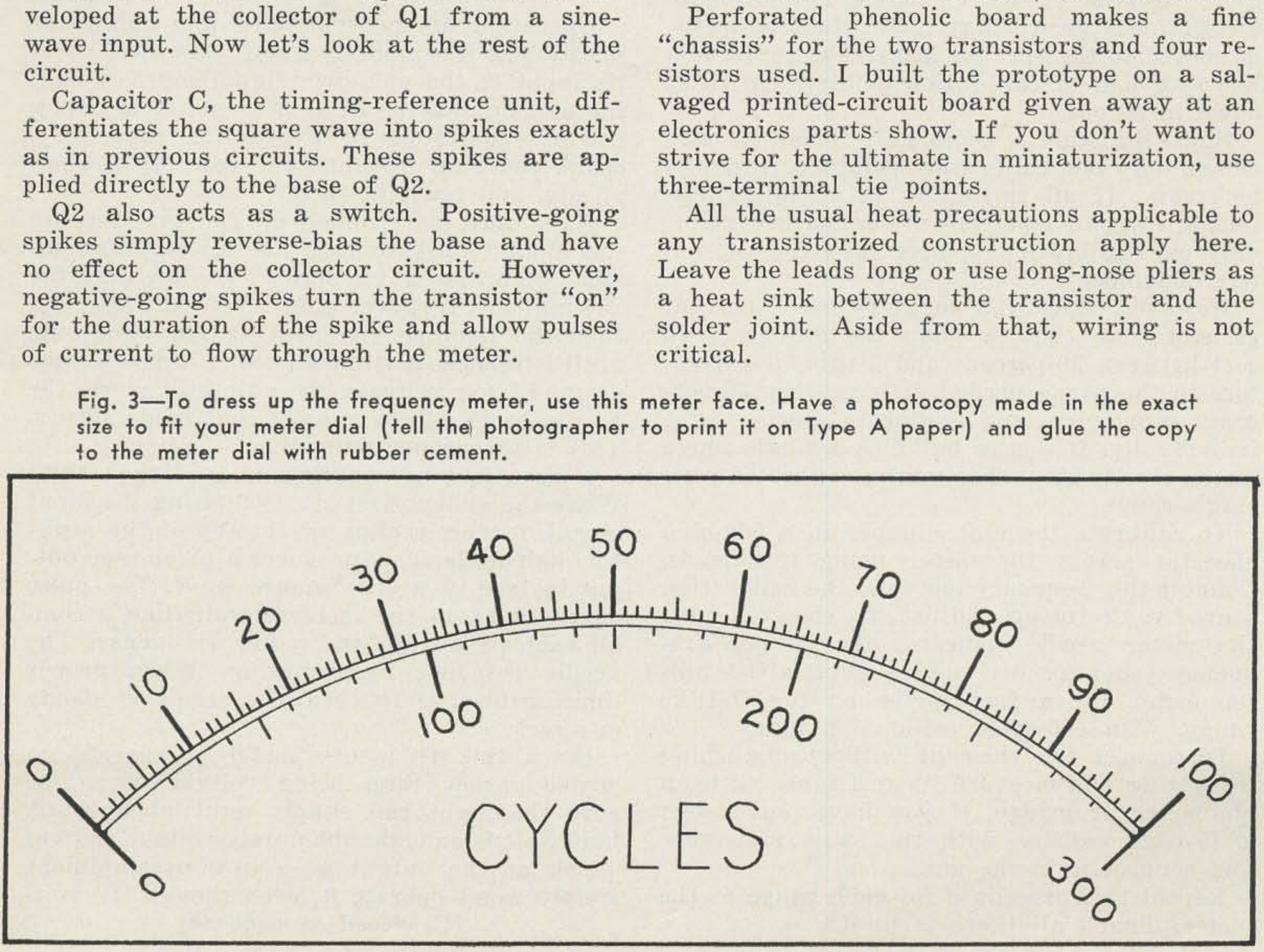
Since the amplitude of the spikes is increased through Q2's switching action, an inexpensive meter is highly satisfactory. The circuit provides linear operation up to approximately 10 milliamps current flow through the meter. Earlier designs required movements in the 1 ma to 100 microamp range for linear operation.

That's how it works. Now, to construction.

Perforated phenolic board makes a fine "chassis" for the two transistors and four resistors used. I built the prototype on a salvaged printed-circuit board given away at an electronics parts show. If you don't want to strive for the ultimate in miniaturization, use three-terminal tie points.

All the usual heat precautions applicable to any transistorized construction apply here. Leave the leads long or use long-nose pliers as a heat sink between the transistor and the solder joint. Aside from that, wiring is not critical.

Fig. 3—To dress up the frequency meter, use this meter face. Have a photocopy made in the exact size to fit your meter dial (tell the photographer to print it on Type A paper) and glue the copy to the meter dial with rubber cement.



If you're building a single-range frequency meter, timing capacitor C can be placed on the circuit board also, as can calibration resistor Rc (when its value is determined as described later). For a multi-range meter, these components should be mounted on the range switch.

Whether you are building a single-range or a multi-range meter, leave the calibration resistance out of the circuit at first. It will be permanently connected later, after its exact value is determined.

If you're building a multi-range meter, you can use the meter face shown in Fig. 3. Simply have a photocopy made, the proper size to fit your meter. For a single-range meter, pick the basic movement to show the same values as the frequency range you're interested in—that is, for a 0-3 kc meter range, use an 0-3 milliammeter, etc.

Once the meter is built, calibration comes next. WWV provides a handy source of 440- and 600-cycle tones, but be wary of frequency distortion caused by multipath transmission of the signal. A reliable 60-cycle calibration note can be obtained from the secondary of a filament transformer.

However, the method used on the original provides a number of tones in the range of interest, at very low cost. A hi-fi frequency range test record, such as those distributed by Cook Records or RCA Victor, is placed on a convenient record player and the freq meter is hooked to the speaker leads. The result is a large number of calibration points from 15 kc down to 50 cps.

Since the scale is completely linear on each range, only one calibration point per range is necessary. If all capacitors in a multi-range unit are within 1 percent of the marked value, only one calibration is necessary for the entire instrument.

However, since you can buy five 5-percent resistors far cheaper than the difference in cost between 20-percent and 1-percent capacitors in the range needed, let's use the 20-percent capacitors and calibrate each range individually. If you're building a single-range meter, simply stop when you've calibrated your single range.

To calibrate the unit, jumper in a 500-ohm rheostat across the meter using test leads. Connect the frequency meter to the calibration source you're using. Adjust the rheostat until the meter needle indicates the proper frequency (such as .6 if you're using a 0-1 milliammeter for a freq meter on the 0-1 kc range, with 600-cycle calibration tone).

Disconnect the rheostat without disturbing its setting and measure its resistance with an ohmmeter or bridge, if you have one. Select a ½-watt resistor with the same resistance and connect it in the unit.

Repeat this procedure for each range of the meter. That's all there is to it.

On a multi-range meter, you may find it easier to get the exact resistance value needed by connecting a number of small resistors in series. When you do this, you may be able to cut down the number of resistors used by noting the resistance necessary for each range, then making up the smallest resistance first. Add just enough to it to reach the next higher value, then enough more for the next, and so forth. Bring out taps to the range switch. A glance at Fig. 4 may make this clearer.

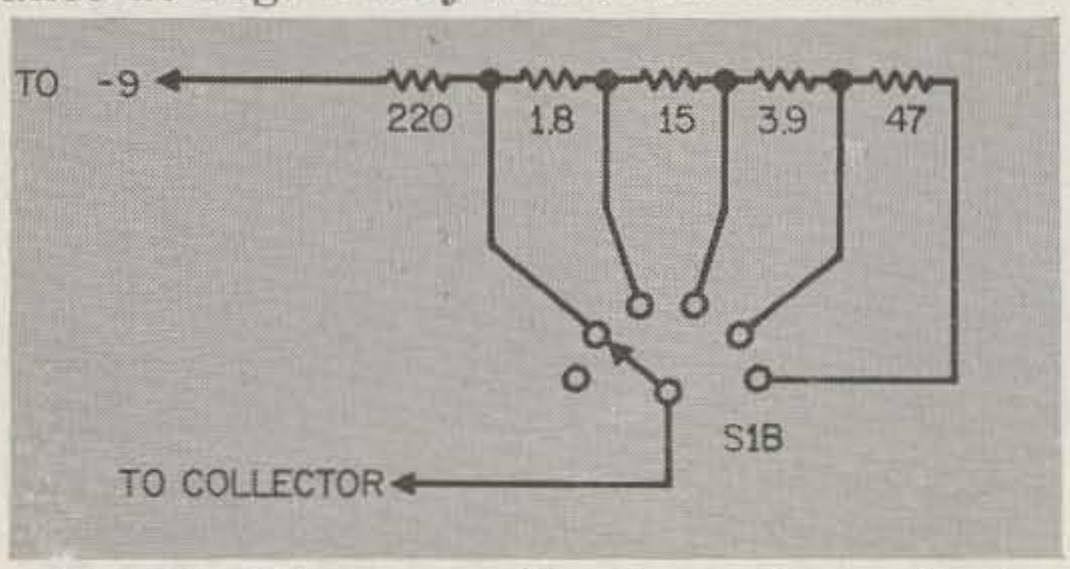


Fig. 4—Alternate calibrating-resistor circuit discussed in text. Values shown for resistors are for example only—the exact value to be used in each position must be determined after the instrument is built as described in text. In this example, position 1 gives 220 ohms; 2 gives 221.8; 3 gives 236.8; 4 gives 240.7, and 5 gives 287.7. If necessary, switch contacts can be jumpered to give identical resistances or the sequence reversed to give lower resistance on higher range.

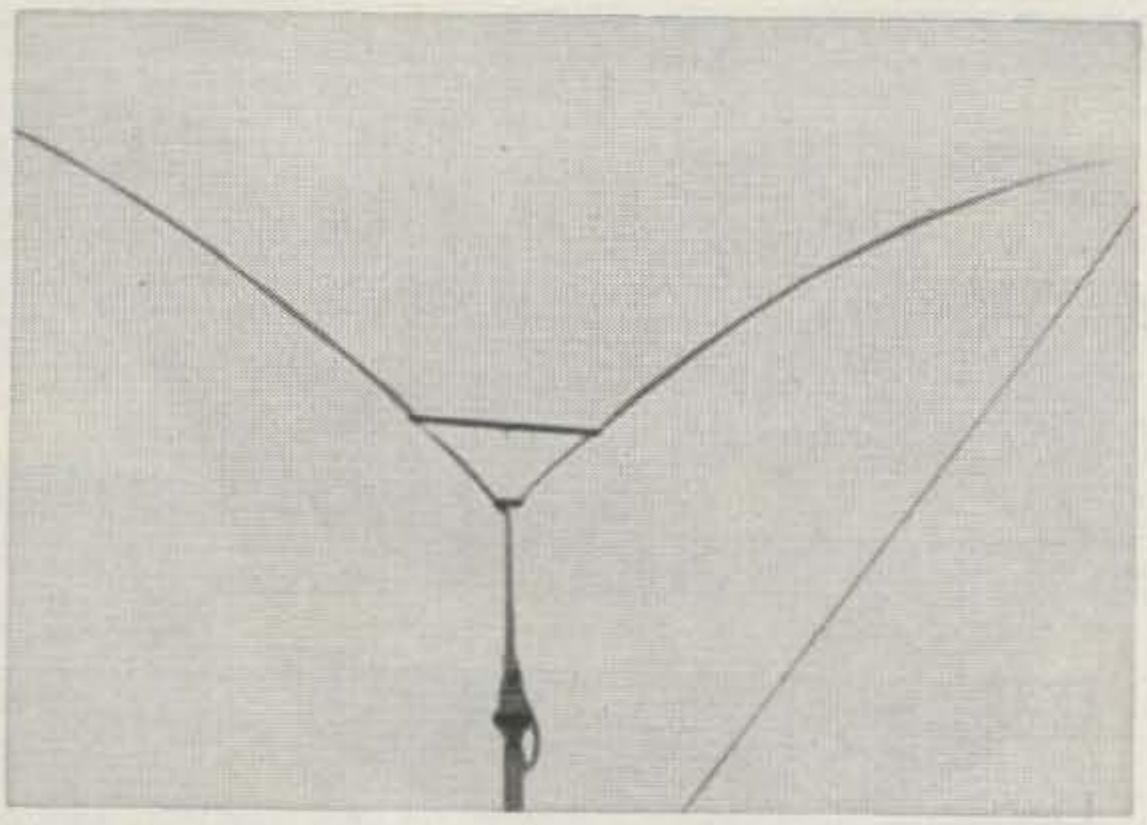
Operation of the completed and calibrated instrument is simplicity itself. Simply connect its input to the unknown signal source (making certain that no dc is present; if in doubt, use a transformer or a coupling capacitor), crank the gain up until the reading becomes steady, and read the meter.

Gain must be cranked up for this because the input transistor acts like an amplifier instead of a limiter for signals smaller than the 200-millivolt turnover point. You will also find that the reading increases as gain goes up, until it reaches a point at which it comes back down. If you increase the gain still more, the needle backs off to a point and holds steady. This is the proper indication.

Reason for the variation in reading is this: When the gadget first starts limiting the input signal, it merely clips off the top of the negative half-cycle. This produces a pulse-type output instead of a true square wave. The pulse output acts, to the meter circuit, like a combination of a high and a low frequency. The needle responds by wavering. When proper limiting level is reached, the needle is steady as a rock.

Since this frequency meter is current-operated rather than being voltage-driven, be sure the input can supply a little power. A half-watt is enough, but purely-voltage sources (such as the output of a hi-fi preamplifier) simply won't operate it, even though the volt-

(Continued on page 54)



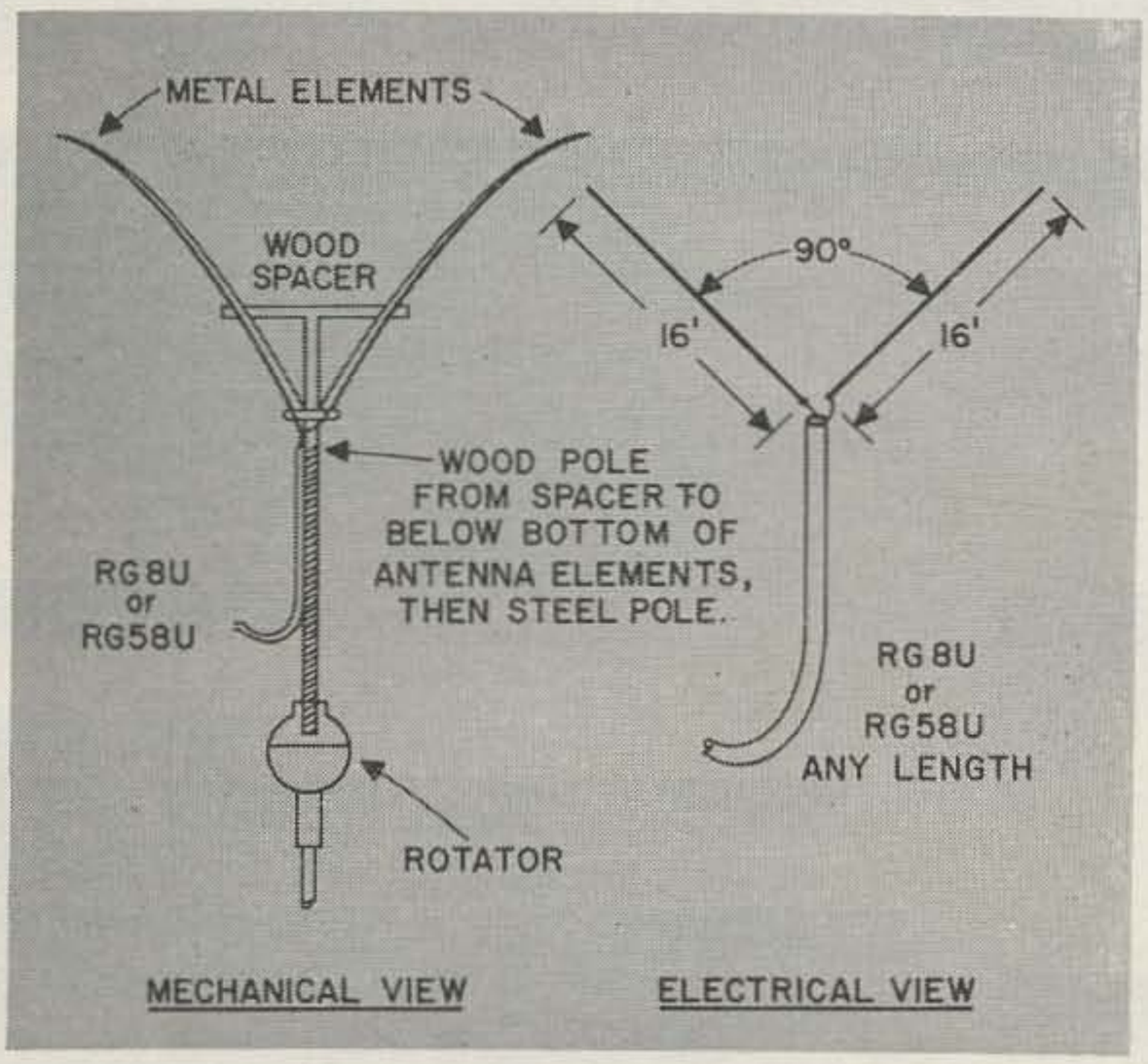
Rotary "Wabbit Ears"

W. G. Rommel, W6EHY
8508 Trask Avenue
Playa Del Rey, California

THE ANTENNA SYSTEM which you are to read about should not be considered as the answer to all problems. It was conceived with two basic thoughts in mind, and as the experiment progressed other advantages became apparent.

The first and probably uppermost in all ham minds is the space necessary to swing any type of rotating device. This has caused the recent swing to "Short and Loaded Beams," which we now see on all sides. It has long been understood that we don't get something for nothing—the short or loaded beams are no exception. To try and reduce the over-all span and yet retain the actual radiation surface was what we needed.

The second problem was one of obtaining as good a pattern as possible with some gain and front to back ratio. All of this, cheap and light at the same time, usually makes the average ham spin his sprockets rapidly. Oh yes, we would also like this gadget to match a 50 ohm coaxial line over say 300 kilocycles.



Now that we have looked the problem over, let's see what can be done. The best place to start is with our old friend the center fed dipole. Let's for the sake of simplicity, stay on 14 megacycles as we proceed. The dipole for 14 megs gives a length of 32′ give or take a few inches per your pet formula. In trying to arrange this long piece of pipe to consume less space and not fold back on itself with the resultant loss of radiation area, you are soon left with one conclusion. The ends must be moved closer together. When we do this, what happens to the antenna as a radiator and how far can one go before the whole thing falls flat on its face? By the use of a scale model and 500 megacycle rf we can find out a lot of information without driving the neighborhood crazy. The feed impedance of a center-fed half-wave dipole antenna is roughly 75 ohms. As the two quarter-wave sections are moved toward a right angle, the feed impedances drop down until, at the right angle position, the feed point becomes approximately 54 ohms. Once the right angle position is reached the feed impedance will change rather rapidly as the angle of the elements is changed a few degrees either way. The 90 degree position has an impedance which looks very happily into a piece of 50 ohm coaxial cable. Further investigation also shows the "Q" to be on the right side for good band width. We now have a full length radiator, which does not throw a shadow as large as it did at the start. We also are now in agreement with the cable which we all love to use.

I know that at this point there are some who will want to close the angle more and reduce the shadow, but let's not push this thing too far because all you will do is make a tuned feed line with very low radiation efficiency.

Well! Now that we have this fine looking device, let's see what happens when we pump

(Continued on page 57)

PROPAGATION CHART

EASTERN UNITED STATES TO

G.M.T.	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
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GERMANY																									
HAWAII																									
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PORTO RICO																									
SOUTH AFRICA																									
U.S.S.R.																									

CENTRAL UNITED STATES TO

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PORTO RICO																									
SOUTH AFRICA																									
U.S.S.R.																									

WESTERN UNITED STATES TO

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U.S.S.R.																									

LEGEND — 7 MC — 14 MC — 21 MC — 28 MC

Propagation Charts

These charts are to be used as a guide to ham band openings for the month of November, 1960 to the various countries listed. I will be interested to hear of your results in using these charts and to know what other areas you might wish included in future charts.

David A. Brown K2IGY
60 New York Avenue
West Hempstead, N. Y.

TO HAVE reliable communications between any two points we must choose a frequency hat is low enough to be reflected from the pper layers of the ionosphere and yet not so ow that ionospheric absorption makes it necssary to run excessive power. Too high a frequency, one that is above the Maximum Usable 'requency (MUF), will skip over the intended eceiving point.

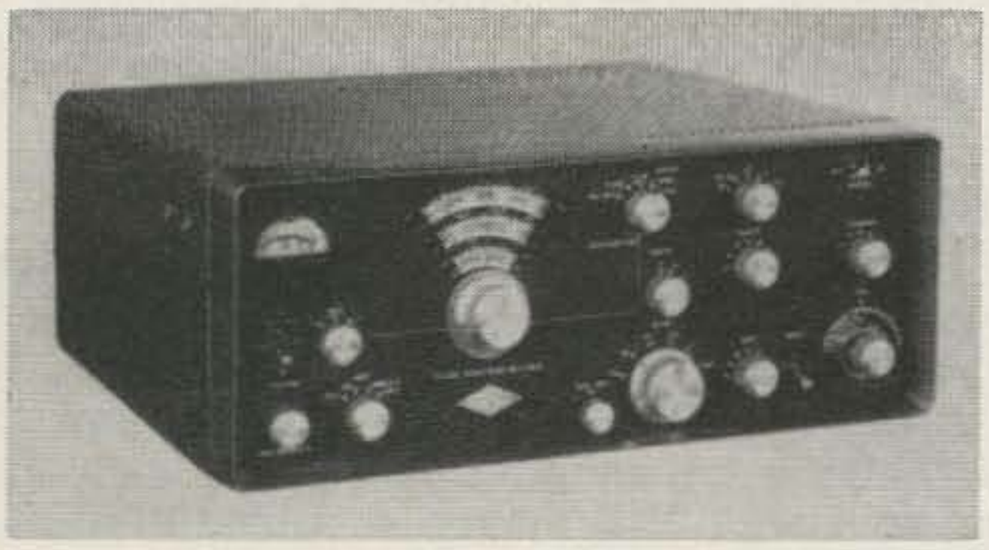
We can predict the MUF by interpretation f charts made by the National Bureau of Standards' Central Radio Propagation Laboraory. From these charts I have made up three charts covering transmission from eastern, central, and western United States to various countries. The bands listed are MUFs and a higher band will not work for the time period listed. Lower bands will work, but not nearly as well. Times are GMT, not local time. 73

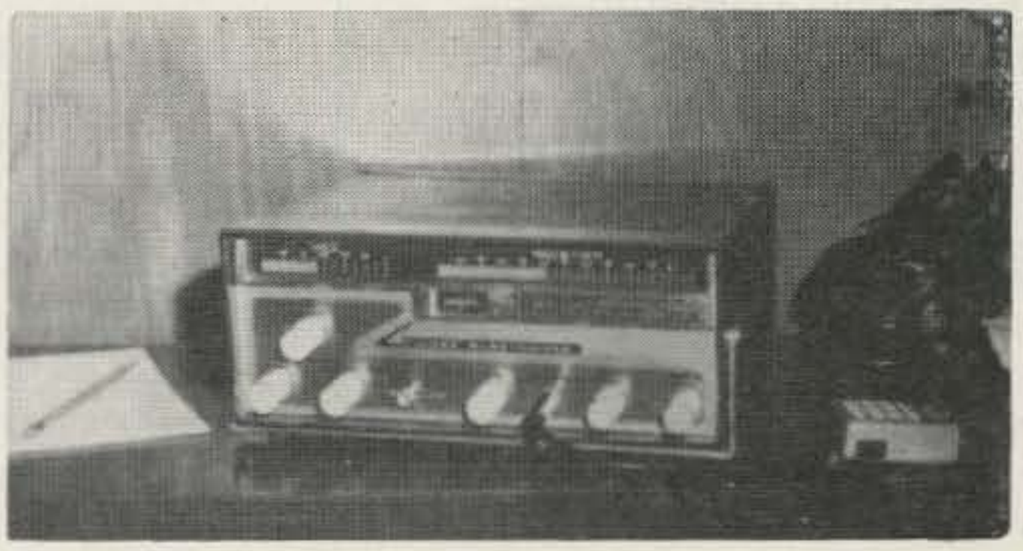
Advance Forecast: November 1960
Good: 3-4, 8-9, 18-21, 24-26, 28.
Fair: 1-2, 5-7, 10-11, 16-17, 22-23, 27, 30.
Bad: 12-15.

New Products

Gonset Transceiver

100 Watts on the hoof . . . if you happen to be orse-mobile. The Gonset G-76 transceiver consists f a complete six band transmitter with 100 watts iput and VFO controlled on all bands except six ieters. This is 100 AM watts too. On CW it will erk at 120 watts input. The receiver is a dual conersion superhet which will tune AM-CW-SSB and as an ideal selectivity curve with 6 db down at 3.5 c. The sensitivity is 1 microvolt for a S/N of 6 db. 100 kc oscillator is available as an accessory. Power upplies are available for 117 v ac with built in peaker or a 12 v dc transistor supply for the car. ze is 1 foot wide and six inches high. Great for ie car or shack. Or both. And hey, when you write r more details, which you **are** going to do, please on't keep it a secret about this writeup being in 73. K? QTH is Gonset Division, Young Spring & Wire orp., 801 South Main Street, Burbank, California.





Globe Transceiver

Globe has added an interestingly styled transceiver to their fine line of ham gear. The "Mobiline Six" weighs in at only 20 pounds, including the built-in three-way power supply (115 vac, 12 vdc, 6 vdc). Size 5" x 12" x 12" is dandy for car or shack. Hmm, lessee what they say here . . . oh yes, 20 watts input to a 2E26, 7 tube receiver, squelch, stable as the dickens, VFO or Xtal control, S-meter, VFO spotting, $229.95 wired and tested. You probably want to know more about this one, don't you. DON'T YOU! OK. Write to Globe Electronics, 22-30 South 34th Street, Council Bluffs, Iowa and mark it to the attention of Howard D. Vann.

MORE NEW PRODUCTS
on Pages 24 and 50

A Critical Look at
EQUIPMENT MANUALS

A. C. Peed, Jr. K2DHA
34 Ashley Drive
Rochester 20, N. Y.

LET'S FACE IT fellows—no matter how much you know about electronics and amateur radio practices, when you purchase a piece of commercial gear you need an instruction manual. It is a sort of "road map" to the location and correct use of all the fittings and controls on the unit. You'll do yourself as well as the manufacturer a big service if you'll first take the time to read the manual *before* you fire up.

But, let's take a look at the current crop of instruction manuals in the light of their use in amateur radio. Are some of the manufacturers being fair with us? Some of their manuals just don't measure up to the purpose for which they are intended.

Physical Form

First impressions are often lasting ones, and the first impression of many present-day manuals is not good. The manufacturer misses a bet for consolidating his favorable position when you open the carton and take out a shiny new piece of gear along with a flimsy instruction book. A two-bit booklet is not a fitting complement for a two- or three-hundred dollar receiver or transmitter!

The physical form of many manuals is poor. Mimeographed instructions folded haphazardly and tossed carelessly into the shipping carton often arrive at the ultimate destination after shipping, torn, frayed, and abraded beyond use. Even if they are received in good condition, after a few months of being shuffled around the bench or operating table they become dog-eared, curled, dirty, and nearly unreadable.

A good manual should have a sturdy heavy-stock cover which can be expected to protect it in normal use for a considerable length of time. Even if the nature of the gear requires that a loose-leaf approach must be taken, there are good inexpensive binders with clasp fittings which will fill the bill in protecting the contents. (If a piece of equipment is purchased which has such a flimsy manual, it is a good practice to purchase some sort of cover or folder to put it in while it is still fresh.)

Another desirable feature of manuals is a binding which will lie open (without weights) at any page in the book so that when used on the service bench it can be referred to while the hands are busy manipulating test prods or alignment tools.

While we are on the subject of physical form, wouldn't it be wonderful if all the instruction manuals were of one standard size? Even if they all fell into the two most common sizes it would help (8½ x 11-inches and 5½ x 8½-inches). But there are always a number of odd sizes and shapes which persist in becoming lost in any bookshelf or file drawer.

Schematics should be large enough to be readable from workbench reading distance, and if they are large they should be bound into the manual in the form of gatefolds which place the entire schematic outside the book when unfolded. This means that the first fold out from the binding should be the left edge of the diagram. (The part of the gatefold which is inside the book can be used for some other purpose such as parts list, tube location diagram, etc.) When schematics are supplied in this fashion, they are fully accessible alongside any page of the text which is of interest with any particular problem. If schematics are supplied loose (not bound-in), a pocket should be provided to hold them in the manual.

Manuals should be illustrated. It takes some very labored text entailing careful reading to describe the location of many components and adjustments which can be shown very simply and directly with a good well-reproduced photograph or drawing properly labeled.

The typography and layout in manuals should be open in character and nicely broken up with white space, illustrations, and subheads. Nothing is more deadly and uninviting than solid pages of unbroken text, especially if it is set in small-sized type closely spaced. It takes a dedicated and determined reader to even attempt to wade into it. And yet, this is a very popular style among manuals—probably on the theory that if a manual has to be provided, all of the essential information should be crammed into the minimum space possible to hold down the printing costs.

Manual Organization

The ideal manual should be organized to make it most serviceable. In the case of manuals for amateur radio equipment, the following organization seems appropriate.

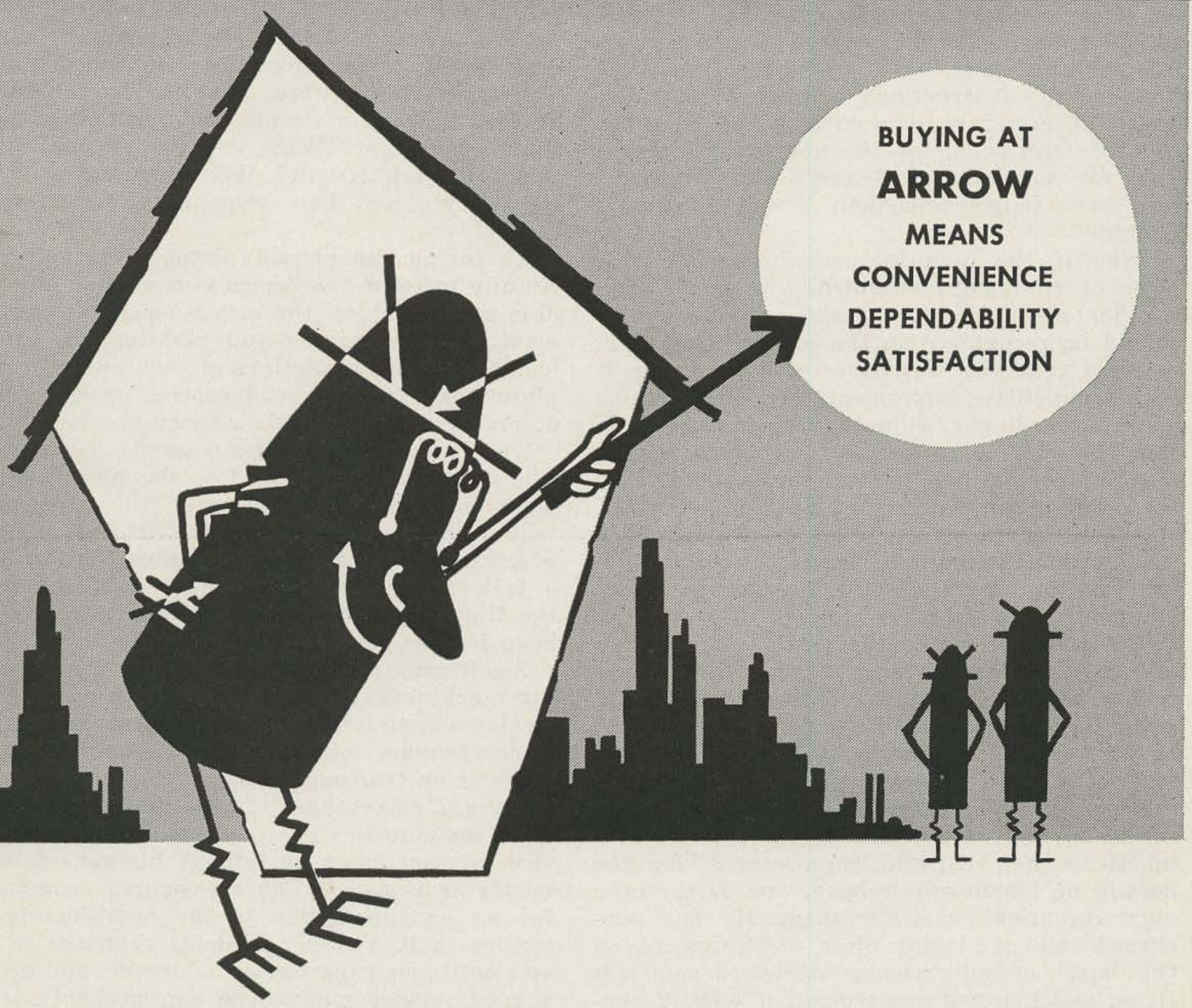
First, a brief table of contents, so that the organization of the manual can be quickly ascertained and any section located without having to thumb through the whole book. (Any instruction book of over about 8-pages in length should have a table of contents.)

The first section of the text should detail briefly and clearly how the unit is to be installed, calibrated, and tested. After all, who can resist putting a new piece of equipment in service as soon as possible to see how it is going to work? The maker should tell you how

ATTENTION HAMS!

ARROW ELECTRONICS, INC.

ONE OF YOUR MAIN SUPPLIERS OF AMATEUR RADIO GEAR POINTS WITH PRIDE TO THESE IMPORTANT FACTS:



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to do this quickly, but in a safe and sane fashion. And, in this same section all of the safety precautions should be strongly emphasized. This means those precautions which should be taken for the operator's protection as well as those which will prevent damage to the equipment through misuse.

If the gear in question is to work with interconnections to other pieces of equipment, these should be detailed separately according to the possibilities. If designed to work with several different makes of auxiliary equipment, list the interconnections separately. All of the possibilities should not be covered in one section full of "if's" and "or's" and other modifications of the instructions according to which brand of auxiliary equipment is to be used. In other words, all of the necessary instructions for connection to Brand X should be covered in a paragraph, then Brand Y, Brand Z, etc.

Even if the manufacturer has made this piece of equipment specifically to work with another piece of gear of the same brand, it should be recognized in the manual that it is possible that the purchaser will be using it with competitive equipment, and instructions given accordingly. Simply refusing to state that the unit will work with auxiliary equipment of competitive manufacturer won't help the sales of anybody's products. If Brand X sideband generator can be used with Brand Y transmitter the manual should say so and detail how, and we'll all benefit—manufacturers and consumers alike.

The next section of the text is one that is of great importance and yet one that is too seldom seen in manuals. This section should cover the "philosophy of the design". It should be written in more leisurely essay style than section one and be designed for careful reading by the owner after he has worked off his initial burst of enthusiasm to try out the lash-up. He is then ready to learn some of the fine details of his new purchase, and he is in a very receptive mood for them. He has purchased this particular piece of equipment on the basis of advertising, dealer demonstrations, and his own assessment of how it compares with competitive offerings of the same general type. He has decided which offers him the most satisfaction for his investment, and he has backed this decision by putting up the purchase price. Under a similar set of motivations, others have decided on other brands of equipment, and it is the nature of amateur radio operators to expect that each new owner is going to have to defend his choice on the air and at local radio club meetings. So, he is going to be looking for information and the maker should arm him with sufficient data to make the defense easy.

The manufacturer must realize that the average amateur of today could probably design and build a pretty good receiver or transmitter if he had the time and shop facilities Hence, he can be expected to understand an appreciate a good bit of commercial design i it is described to him. Amateur gear is no like washing machines with which it is suffi cient to inform the user which buttons are t be pushed to perform a washing—as long as satisfactory wash job comes out the consume will be happy and not give a hoot what goe on inside the machine. No *good* amateur op erator should be content merely to assess th output of his rig without knowing what i behind the panels.

So, this second section of the manual shoul describe the design from the ground up—stag by stage. Why were the particular tube chosen? Why this circuit configuration rathe than some other? What are the unusual fea tures of each circuit? What are the critica components and how were they chosen an tested?

There is a plus in this for the manufacture A fully informed customer is more likely to b able to understand the operation of his equi ment and its service and maintenance prol lems. Hence, fewer letters of inquiry and con plaint, and fewer trivial service problems. I other words, more satisfied customers.

The last section of the manual should co tain complete and detailed service and realign ment information. Admittedly, the purchase will probably only glance at this, but it wi give him a secure feeling to know that he ha a full treatment on service available again the time when it may be required urgently keep him on the air.

Again amateur equipment differs from wash ing machines. It is easier to find a competen local washing machine repairman than it a serviceman for an ailing communication receiver or transmitter even in a fairly larg city. So, Mr. Average Ham in small to mediun sized communities has to take on his own se vice in most cases, or submit his gear to th tender mercies (?) of the express compan for an expensive trip to the manufacturer service shop. Yet, Mr. Ham is supposed to b an electronics expert of some degree, and give a good service manual he can probably tak care of most of his troubles himself.

In preparing the service section, the manu facturer should bear in mind that the indi vidual who may be using this informatio probably doesn't work full time at electron service. So, the test equipment and test pro cedures should be detailed more than in manual intended expressly for servicemen. Fo servicemen, it is adequate to tabulate alig ment frequencies and the adjustments whi are to be made. For the amateur, these shou be spelled-out with full information as where to inject the signal, the type of sign (frequency, modulation, amplitude), where read-out the alignment indication, etc. The fu time serviceman can be assumed to know the

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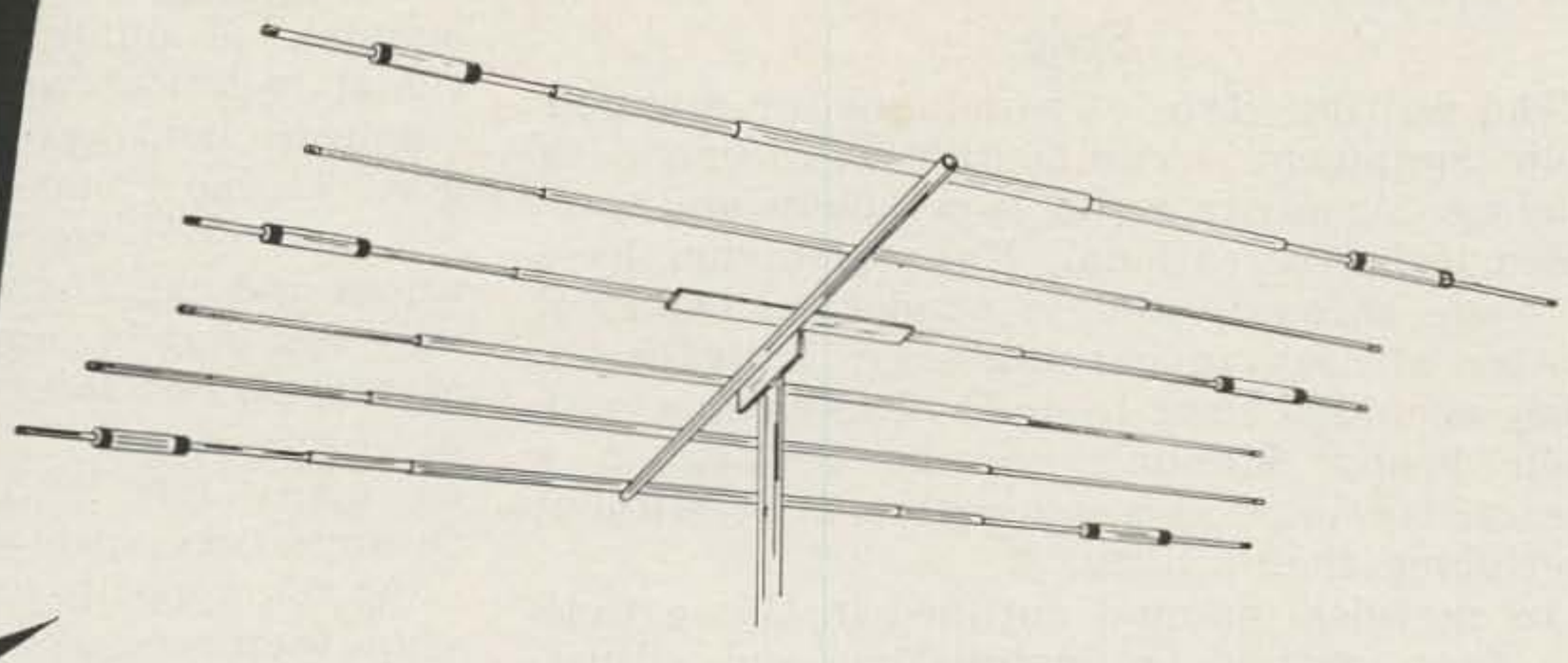

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things, but not the average ham doing an alignment on the kitchen table with borrowed test equipment.

Style

The writing style of a manual for amateur radio equipment should be light and fairly easy reading. Amateur radio is a hobby and supposed to be recreational. Many amateurs have to wade through stodgy, ponderous technical matter all day in earning their daily bread. They shouldn't have to do the same thing with their hobby. Manuals can be written in a reasonably lucid and interesting style without sacrificing their utility.

In the ideal manual outlined in this article, the first section, on installation and adjustment, should be in a brief, succinct outline style which will entail the least study to put the equipment in service efficiently.

Section two discussing the design and operational features should be in a more complete essay form much like the New Apparatus features in the amateur magazines. This can be a rather casual style minimizing design formulas and mathematics. The reader will be willing to assume that the designer has performed the mathematics and data evaluations properly without going through them in the text.

Section three on service should be full service information in a detailed and straightforward fashion. It need not be styled for complete reading at one sitting as with section two. Instead, it should consist of capsule sections covering completely in themselves one facet of the service. In this section, the manufacturer should be frank and candid about service problems which he may anticipate with this gear on the basis of his previous experience or a projection of his knowledge of this particular circuit. Points of likely breakdown should be enumerated along with the operating symptoms of such breakdowns, and procedures for locating the fault and repairing it.

Finally, the matter of parts lists: A parts list is not much use to the individual owner if it lists the parts only by the manufacturer's stock numbers. Admittedly some of the components will be specially fabricated or selected for the circuit and these it will be necessary to obtain from the manufacturer's parts department. But, there is no need to have to order common values of resistors and capacitors from the manufacturer when they can be obtained locally. The parts list should therefore contain, in addition to the stock number, a description sufficient to allow local procurement of a replacement. And, if the component is special for some reason and should be obtained only from the manufacturer, the parts list should point this out.

Manuals should not be a hastily composed after-thought. Many manuals appear to have been written by the project engineer after he finished the design and passed it on to the production department and was contemplating a well-earned fishing trip. His boss says, "Oh yes, before you leave, you'd better whip out a manual." Manuals should be written by professional technical writers with the help of the engineers and service people. Rarely does a good engineer have the heart for a writing job, and even more rarely does he have the talent and experience. The small manufacturer may say that he can't afford a full-time manual writer, but this is no excuse because there are professional technical writing firms as well as many free-lance technical writers eager to undertake such projects.

At the opposite extreme, there are the large manufacturers who do a great deal of government contract work and have full-time manuals departments. It is natural to throw manuals for their amateur line into the same mill. From the amateur's viewpoint, what comes out can be pretty ghastly! Manuals written to military specifications are too formal and ponderous for the average ham, and will be largely ignored because they are such heavy reading.

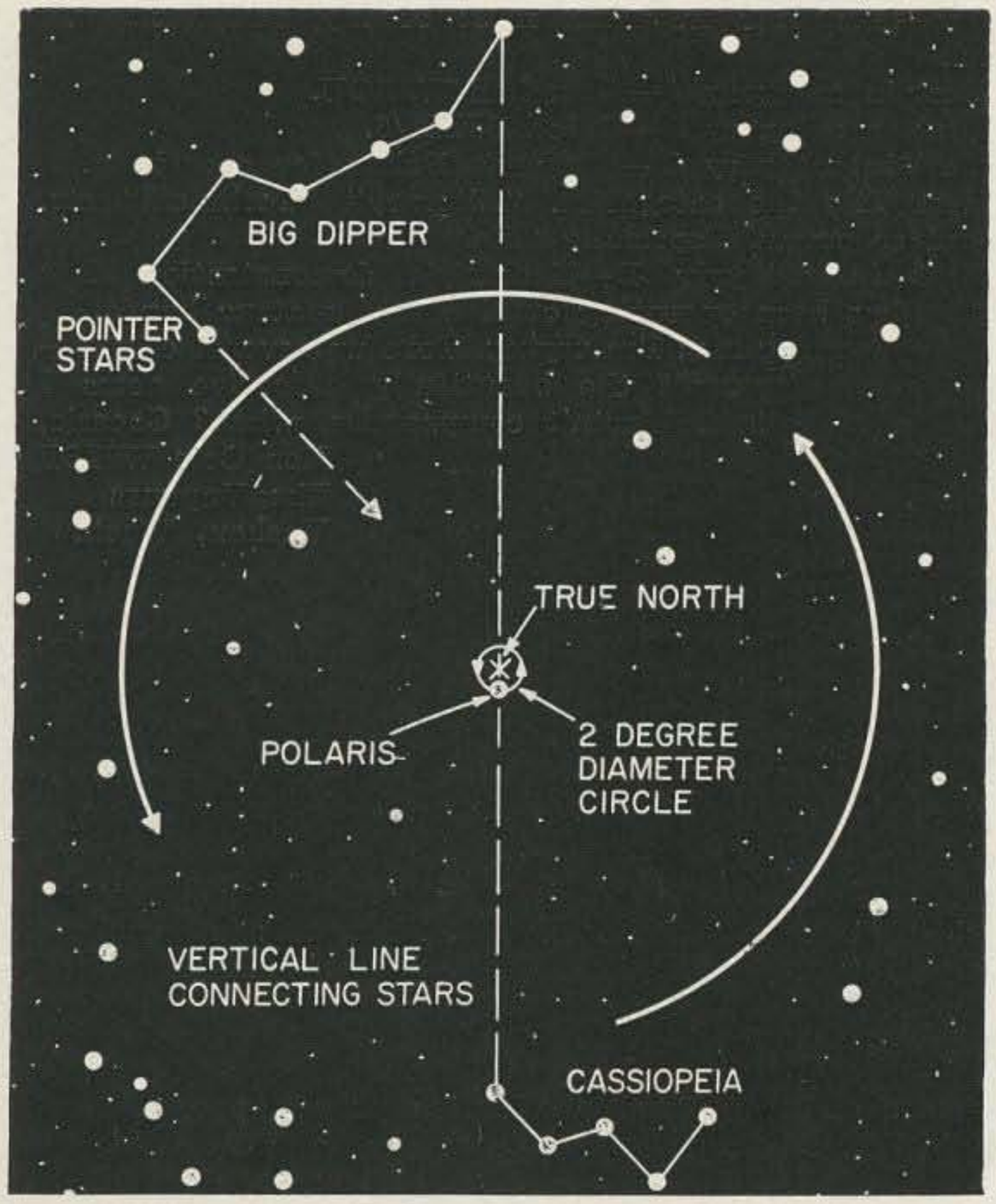
What You Can Do

The next time you consider purchasing a piece of commercial gear take a critical look at the manual. Does it measure up to the job that it must do for you? It is as much a part of your purchase as the tubes in the equipment. Both the equipment *and* the manual should be attractive, sturdy, and serviceable. If the manufacturer has slighted his duty to you on the manual, you are being short-changed.

As a practicing consumer of amateur equipment you can do something about manuals. If you don't like the ones that you receive, tell the manufacturer. Maybe he'll do something about it the next time around. Because no complaints are heard many concerns feel that they must be doing a satisfactory job.

Be fair to the manufacturer (and yourself), read the manual. Keep it in a secure place where it can be located on short notice. Refer to it when you have a question *before* you write a letter of inquiry. Fully half the letters received by equipment manufacturers ask questions which are already answered in their manuals.

The manufacturer who supplies manuals of sketchy content and indifferent make-up is missing a wonderful opportunity to consolidate his position as "most favored brand" in the minds of his customers. Well-done manuals are an excellent form of institutional advertising for building up the corporate image in the purchaser's subconscious. The customer may buy another piece of gear in the future. If he is satisfied with all aspects of his future. purchase, he can be expected to consider favorably the same brand again. If not, he will buy almost any other brand in a conscious attempt to avoid the brand with which he was dissatisfied. • 73



Constellations as they appear around 2100 local time in June. Note 2 deg. diameter circle described by Polaris as earth rotates about True North. True North is one deg. from Polaris

Finding True North

Calvin R. Graf, W5LFM
207 Addax Drive
San Antonio 1, Texas

JUST about all amateur radio operators and astronomers know that Polaris, the North Star, is near the point of True North. But just how close is it to this exact point and how can True North be found from Polaris?

Specifically, Polaris is almost one degree (55.4 minutes of arc) away from true north and as such describes a circle of two degrees diameter as the earth rotates once each 24 hours. Anyone interested in aligning a high gain antenna or telescope must know how to make corrections to align their instrument to the true point.

Figure 1 is a sketch which shows a line connecting the constellations Ursa Major (Big Dipper) and Cassiopeia and which passes through Polaris, the first star in the handle of the Little Dipper.

The line connects the first star in the handle of the Big Dipper and the first star in Cassiopeia. The important point to note is that True North lies one degree (55.4 min.) from Polaris *toward* the Big Dipper (or away from Cassiopeia). True North must then be transferred to a ground base line by means of a surveyors transit for use with antennas which rotate in azimuth only.

While the Big Dipper is quite well known, Cassiopeia has not enjoyed this popularity except with radio astronomers who know Cassiopeia A as a source of intense radio noise. During early winter nights, Cassiopeia appears as an M and in summer as a W.

The Big Dipper and Cassiopeia will be above the northern hemisphere horizon only during certain hours and certain months of the year. The easiest corrections can be made when the connecting line lies horizontal or vertical. Some time during the night, regardless of the season, the Big Dipper or Cassiopeia will form a straight vertical line with Polaris. This happens around 2100 local time in early June and 2100 local time in December.

In June the correction is one degree from Polaris *toward* the Big Dipper. In December the correction is one degree from Polaris *away* from Cassiopeia. In both cases the correction is in a vertical line. Correction at other times (and therefore angles) when the line is not vertical is more difficult because of the gyrating action of Polaris. Using this method, True North can be found within a few tenths of a degree of arc. 73

Letters to the Editor

Dear Wayne,

I won't take up your time with a lot of idle chit-chat. I just wanted to let you know that I am delighted with the first issue of "73".

There are many things I like about the new mag, but I will mention only a few. First off, the first thing I noticed was that it took me nearly as long to read as the famous "giant-sized" ham mag and the New York "middle-sized" thing. I guess that must prove something about ratios of advertising to solid content.

I also like the white space ratio. Your magazine is undoubtedly the easiest on the eyes of any I've read. Your circuit diagrams are also easy on the eyes and lesss confusing to boot. The three shade color selective scheme makes it easy to study the circuit without being distracted and confused by the dimensions and part values and vice versa.

Another thing I like is the propagation chart. It is simple, clear, and easy to read. That is very important in a ham magazine because very few of us are in need of charts which go into such detail that they could almost be used "as is" by commercial point-to-point stations.

Keep up the good work, Wayne. You've got an excellent magazine started here—one which, if given a good chance, may well produce some interesting changes in the circulation "standings" in the ham magazine field. I certainly hope so.

Jim Grubs, W8GRT/K9HBV
Toledo 13, Ohio

Dear Wayne,

Glad to see you back in business: you seem to have the insight into what the thinking ham needs in editorials, articles, and last but not least, your humor. Don't ever lose that. I have loads of other commen's but hate to write so just remember I am delighted to have you back.

Gilbert Loescher K2QOJ
Buffalo, New York

Lieber Fuhrer:

Qualified congratulations on issue #1! Well, as a subscriber I qualify, don't I? Relative ratings volunteered below—but bear in mind most of my relatives can't read.

Best in category A—Campbell W2ZGU.

Best in category B—Kyle K5JKX/6.

Best in category C—The rest. Prizes for everybody.

You title the categories. "Literary" "Technical" etc. sound so corny. Especially "etc."

Best in category D—Kennedy's demonstration that Nixon has been operating outside the amateur bands.

Stop nagging me; I'm trying. Tore up several efforts—they simply weren't the beautifully evocative gems I demand of myself. Mustn't compromise, what? Cheerio,

Ken Cole W7IDF
The Vapours
Vashon, Wash.

Dear Editor,

This is the first letter to any editor I've ever written, but I couldn't resist. On page 28 of 73 (which my OM, K2OYW just brought home today) there is an article on shock by Peggy Bates.

There is another method of artificial respiration that has received official recognition and widespread publicity lately, namely mouth to mouth. It is extremely easy to perform and lends itself to oddball situations, like the tops of poles, for application. . . . There is an excellent film, "Rescue Breathing" demonstrating this procedure. I can't recall who puts it out, but here in the Camden area the State Police from the Hammonton Barracks will travel any reasonable distance to show it. . . . Immediate and continued application of an easy, efficient method of artificial respiration may save lives.

Marlene Denber, R.N.
Barrington, N.J.

Well Marlene, Peggy Bates was a staunch advocate of the mouth-to-mouth method of artificial respiration for drowning, but when she researched for the 73 article she found that the older methods had advantages. The M2M system is not as effective in circulating the blood due to the nerve paralyzation which accompanies electrical shock.

New Products

Rohn has a new tower for you fellows who are getting a little lazy about climbing up the tower every time the rotator needs some attention or who balk at lowering the beam every time you want to make an adjustment. It's triangular, 12½" on a side, comes in 10' sections and will go up to 70'. The kit includes (yes . . . kit, did you expect it to come already assembled?) the boom, cable, windlass and special hinged section. May we suggest that you write Rohn at 6718 West Plank Road, Peoria, Illinois for details. You already know about telling 'em it was in 73.

This new EICO 60 watt CW transmitter, weighing in at only 15 pounds, should be of considerable interest. It covers ten through eighty meters, band-switching, and comes either wired at $79.95 or in kit form for only $49.95. There is a provision for plugging in a modulator, VFO, antenna relay, etc. Size is 6" high, 8½" wide, 9" deep. Write EICO, 33-00 Northern Blvd., Long Island City, N. Y. and ask for details on their Model 723.

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Other Ham Publications

RATHER than devote half or more of 73 to the printing of news of interest to specialized groups we believe that it is our function to do everything possible to encourage the publishers of bulletins which cater to these interests. These bulletins bring you the news you want in far greater detail and in much less time than is possible in a monthly magazine where it usually takes two months for news to get into print.

HAM-SWAP. Published by Ham-Swap, Inc., 35 East Wacker Drive, Chicago 1, Illinois. Editor is Ed Shuey, K9BDK. Subs are $1 per year by 3rd class mail, $3 for 1st class, $5 airmail, and $7.20 special delivery. Published twice a month. Contains classified ads entirely. This is your best bet for an inexpensive way to sell or swap some gear in a hurry. Within two weeks people are answering your ad.

FLORIDA RTTY BULLETIN. Fred W. DeMotte W4RWM, P.O. Box 6047, Daytona Beach, Florida. $3 per year including membership in Florida RTTY Society. Mostly operating news with a bit of technical info now and then. All TT men should be getting this.

SOUTHERN CALIFORNIA RTTY BULLETIN. Merrill L. Swan W6AEE, 372 West Warren Way, Arcadia, California. $2.75 per year, not including membership in Society. Operating news and some technical articles. This is the oldest TT bulletin going. All TT men should also get this one. Monthly.

73 HAM CLUB BULLETIN. Marvin Lipton VE3DQX, 311 Rosemary Road, Toronto 10, Ontario, Canada. Sent free to all editors of ham club bulletins monthly to keep them abreast of what is going on with all the other ham clubs. This is an excellent source of news for putting together your club bulletins. To subscribe to this news bulletin just send a copy of your own club bulletin to Marvin.

WESTERN RADIO AMATEUR. Don Williamson W6JRE, 10517 Haverly Street, El Monte, California. Monthly. Subs are $2 per year, $3.50 for two years, $5 for three years. Operating news of west coast activity, columns on DX, SSB, YL, and some articles. 48 pages.

SIDEBANDER. Official organ of the Single Sideband Amateur Radio Association, 12 Elm Street, Lynbrook L. I., N. Y. Subs include membership to SSBARA: $ per year. Monthly. Primarily operating news and chit chat for the SSB DX gang. Columns by W8YIN K5MWU, K6EXT and occasional technical info.

THE MONITOR. Mar-Jax Publishers, 507 West Davis Street, Dallas 8, Texas. $1 a year, 3 years for $2.50 Monthly. Largely operating news. Columns: YL, Club Meetings, Arkansas News, Mississippi News, Florida News, DX, Missouri News, MARS, California News Louisiana News, VHF News, Oklahoma News, Rio Grande Valley News, Novice News.

VHF AMATEUR. 67 Russell Avenue, Rahway, New Jersey. $2 year, $3.50 two years, $5 three years Monthly. Operating news for VHF men. Some technical info.

DX-QSL News Letter. Clif Evans, K6BX, Box 385 Bonita, California. Published quarterly. 40¢ each; Annual subscription $1.25 (four copies) by first class mail ($1.50 for DX stations). Lists all QSL Bureaus managers for rare DX stations, etc.

DIRECTORY OF CERTIFICATES AND AWARDS. Cli Evans, K6BX, Box 385, Bonita, Cal. Complete Directory plus one year of revisions (quarterly) $3.50. Add 75¢ for 1st class mail; $1.25 for airmail; DX station 1st class mail add $1.00. Needless to say, this is the most complete collection of data on the hundreds of certificates and awards available.

MOBILE NEWS. Published monthly by the Amateur Radio Mobile Society, 79 Murchison Rd., Leyton, E 10, England. Joining fee and 1 year sub. is $2.50

DX BULLETIN. Don Chesser W4KVX, RFD 1, Burlington, Kentucky. DX news in depth. Published weekly 3rd Class mail $5 year; 1st class $6; Airmail $7.50 DX rates on request.

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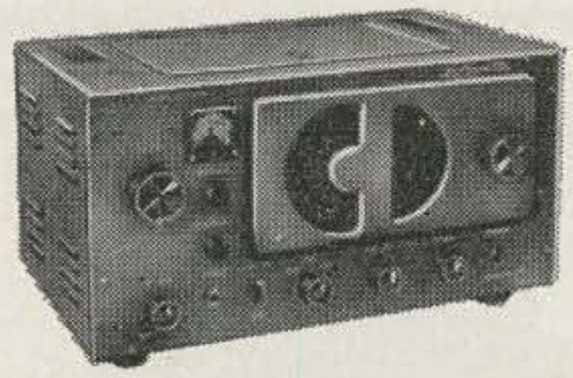

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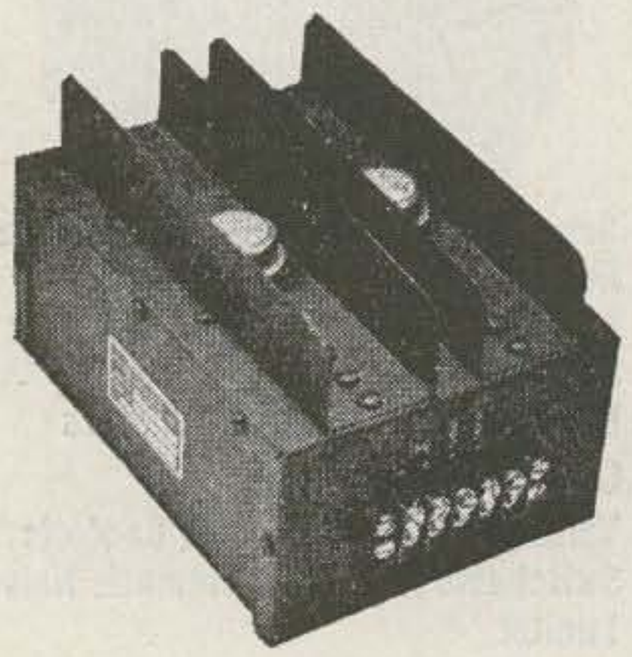

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GLOBE

ELECTRONICS DIVISION
GLOBE INDUSTRIES, INC.
525 MAIN STREET
BELLEVILLE, NEW JERSEY

(FREQUENCY METER from page 40)

age is far above the 200-millivolt level. If this seems a disadvantage, it can be overcome by putting an emitter-follower amplifier ahead of the limiter circuit as shown in Fig. 5. This amplifier was omitted in the prototype be-

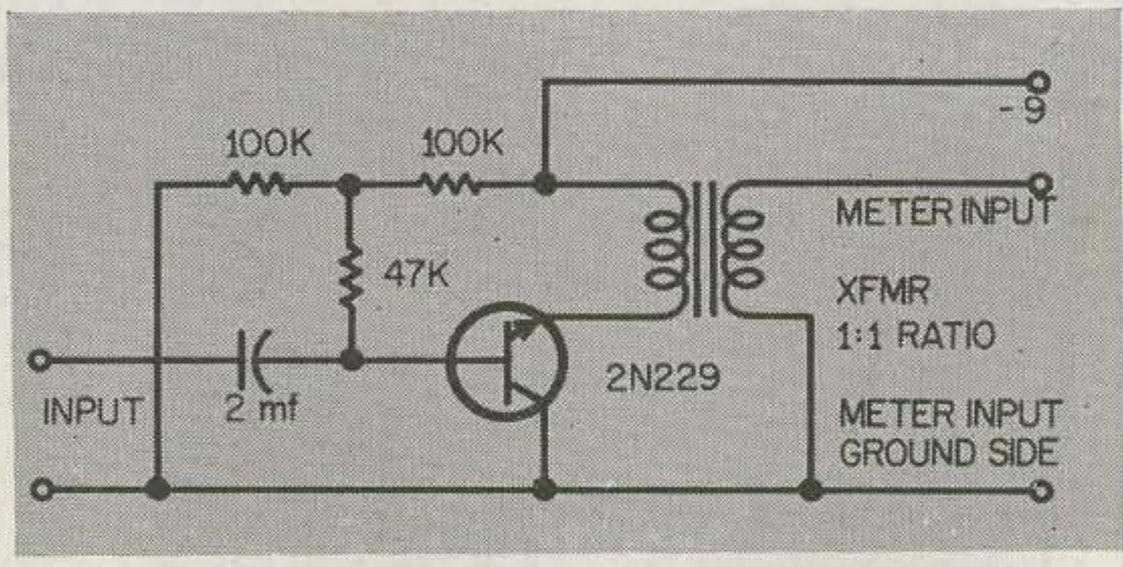

Fig. 5—This tiny preamplifier may be added to the input of the frequency meter to increase the meter's ability to indicate frequency of voltage-only sources. The emitter-follower circuit has an input impedance of nearly half a megohm, reducing loading effects, and provides more than 10 db current gain, which will more than fully drive the frequency meter from any ordinary signal. Any small transistor-type interstage transformer may be used; its prime purpose is to keep all dc out of the frequency-meter input.

cause it was felt unnecessary.

That's all there is to it—except justificatio of the "Five-Dollar Frequency Meter" name Cost breakdown for a single-range unit is:

2	2N107 Transistors	$1.80
1	0-10 ma. meter	2.06
4	½-watt resistors	.60
1	200-volt capacitor	.15
	Total	$4.61

This is based on use of a moving-vane mete and no range-switching features. Use of d'Arsonoval movement and a range switch wi boost the cost a bit, but it will still be ver reasonable for such a versatile unit. Have fu with the freq meter, and happy homebrewing

References

Basic Theory

Electronics Magazine, January, 1945.
Electronic Measurements, p. 223, F. E. Terman and J. M Pettit, McGraw-Hill Book Co., Inc., New York, 195
Basic Electronic Test Instruments, pp. 200-203, Rufus I Turner, Rinehart & Co., New York.
Electronic and Radio Engineering, Fourth Edition, p 606 and 662, F. E. Terman, McGraw-Hill Book Co Inc., New York, 1955.
Transistor Manual, Fourth Edition, pp. 89-91, The Ge eral Electric Company, 1959.

Construction Articles

Radio and Television News, February, 1951, p. 54, Rufu P. Turner (AC operated instrument).
Radio-Electronics, February, 1952, p. 25, H. O. Maxwe (AC operated instrument).
The C-D Capacitor, February, 1956 (Battery operate with tubes).
CQ Magazine, January, 1958, p. 72 (Transistorized i strument).

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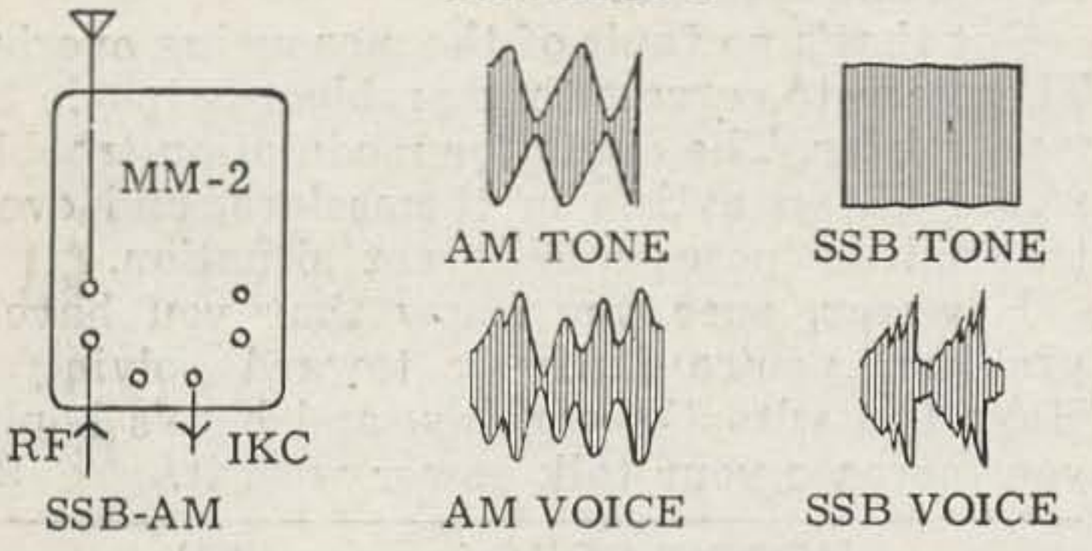
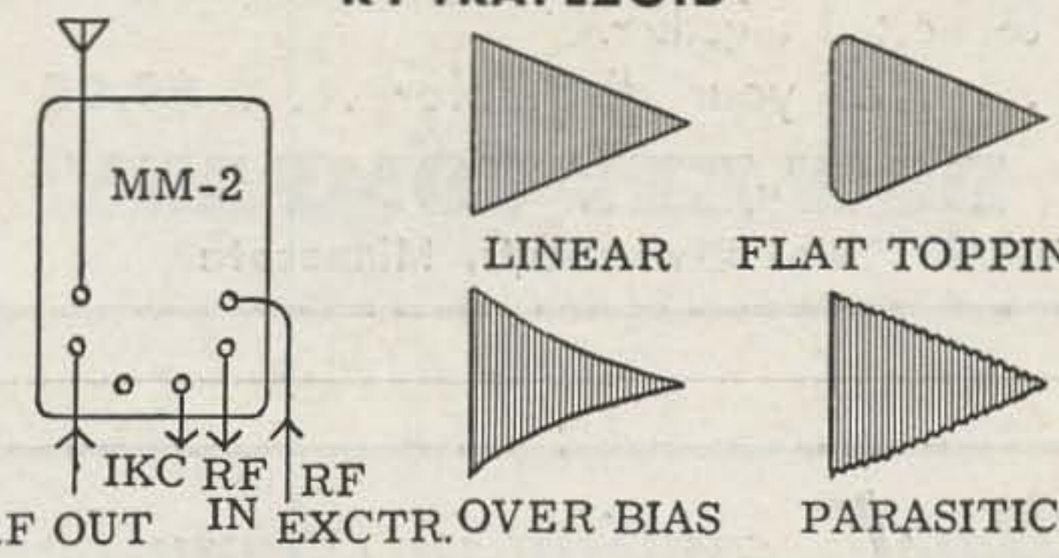
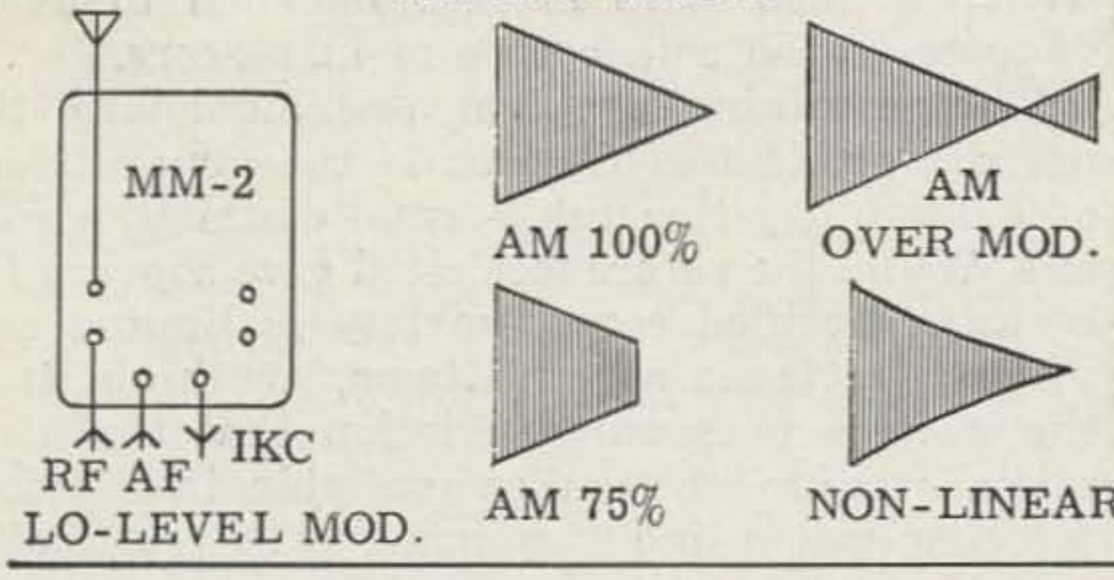


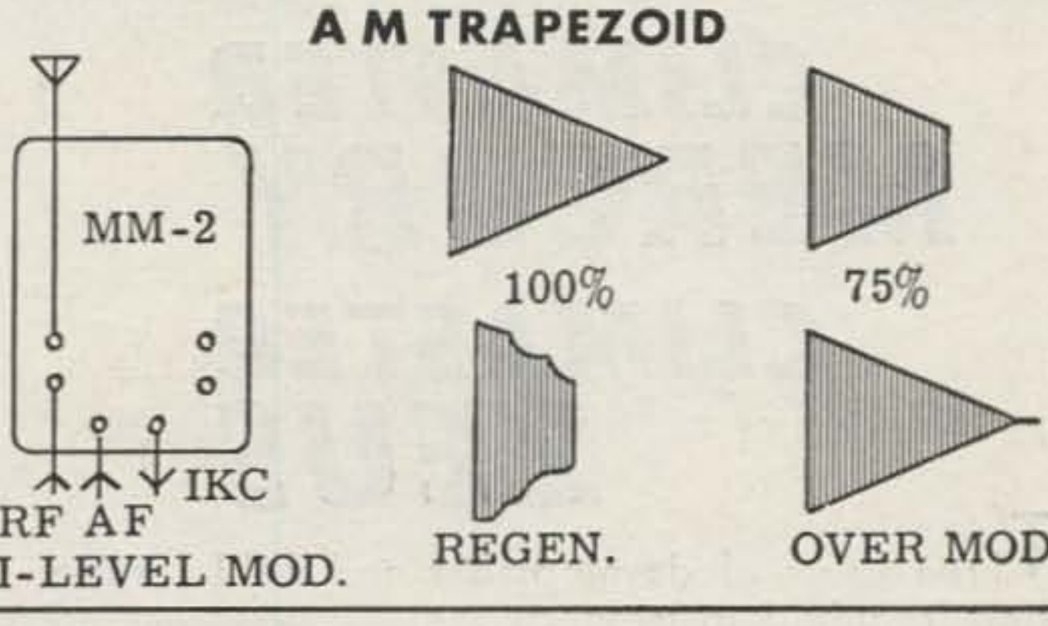
R F TRAPEZOID



A F TRAPEZOID



A M TRAPEZOID



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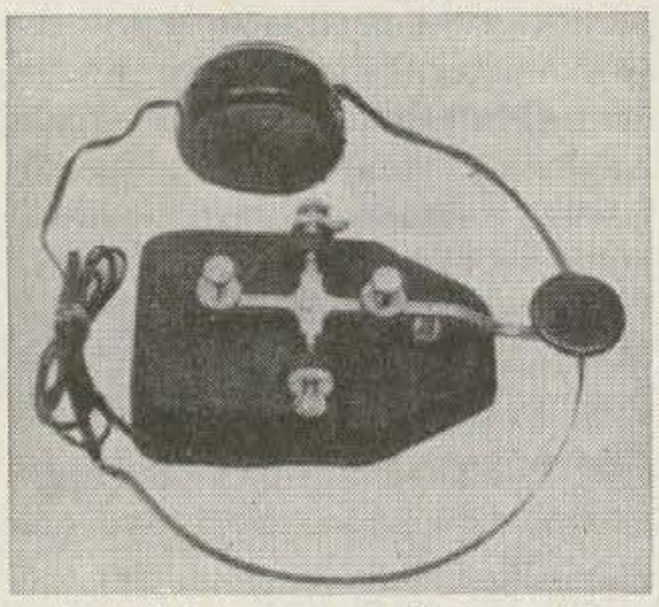

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(MODULATION from page 25)

by means of varying coupling to the final—so that its trace just touches the 0 lines, the minimum voltage trace will be directly proportional to modulation percentage which can then be read directly from the overlay.

When you use this gadget, you'll find that your "modulation level" on CW will read 33.3 percent instead of 0. However, the pattern will not reach to the 0 line at any time on CW unless you readjust the coupling to the final. The additional voltage necessary to raise the pattern from 33.3 percent to 0 percent at the high side on voice comes from the modulator—it's the "talk power" of your sidebands.

You may also be sure, the first time you use this, that something's wrong with the overlay. There's a great possibility that you'll read less than 70 percent modulation.

Dont' cuss the gadget. The facts are sad but true; a majority of ham transmitters presently on the air produce only about 70 percent modulation level in practice. In many cases, attempting to exceed this level by means of advancing the audio-gain control results in distortion and splatter.

But that's no fault of the measuring overlay. The place to correct that problem is inside the transmitter. The cures for modulation troubles would fill an article in themselves, and every transmitter poses a different situation.

However, once you know that you have a problem, you're halfway toward solving it. Have fun with the overlay, and here's hoping you increase your talk power with it. 7 3

(TOROID COILS from page 37)

with the insulators is recommended to avoid damage to the coil, core and insulators.

The remaining problem associated with the use of ferrite toroid cores is the general lack of availability through normal distributor outlets. While the references cited give sources for certain specified cores, variety is limited and prices, for these special items, are high. It is the writers personal conviction that the alert manufacturer who makes available, in distributor channels, a line of a dozen or so reasonably priced, general purpose toroid cores will make a killing. Cores made of low, medium and high frequency ceramic and supplied in three or four physical sizes should meet most experimental requirements. If this article assists in making these core materials more readily available, it will more than have served its purpose.

The radio amateur has been responsible for many state of the art advances in the dual fields of communications-electronics and this new area offers fertile ground for experimentation. Try working with toroid rf inductors. Increased knowledge and skill will be yours, since the surface is barely scratched in amateur and commercial application of this new component family. 73

(WABBIT EARS from page 41)

some rf into the feed line as far as pattern is concerned. First we find that the usual figure eight pattern that we get from the standard center fed dipole has been modified considerably. The eight figure has lost weight and grown in height, which means we are bi-directional and showing gain on the two sides at right angles to the plane of the antenna. We are also down in radiated energy off the ends of the elements. We are making good progress toward our objective.

We now come to the last, but far from the least, point of interest. With the elements at an angle of 45 degrees from the vertical, we find that the antenna will respond to both vertically and horizontally polarized wave fronts. This is a very nice thing to have at any frequency and at higher frequencies much desired. There are great gobs of "Hairy Old Theories" regarding how waves turn and roll after leaving the antenna system, but anyone who has used a ground plane antenna will confirm the fact that there are times when they can take all comers, and other times when the Horizontal boys take over.

The simplest form of this type of system has been used for about one year at the writer's location. The antenna is cut for 14.100 megacycles and fed with RG8/U cable. The elements are made of sections from tank whip antennas, which are 3 foot lengths and screw together. Each section is also tapered progressively. The base of the 90 degree angle where the feed line attaches, is 25′ above ground. The unit is rotated by a TV type rotator. The effective height of the antenna, using the center of one element as reference, is approximately 32′ above ground.

Using 800 watts input the results have been most gratifying. The DX signals have been increased in intensity to a point where armchair copy is standard practice. The reports from all contacts show a marked improvement in transmitted signal over the ground plane and two-element beams previously used.

The "Dual Polarity Personality" gives substantial evidence of longer staying power during conditions of change in fading periods. Also the "fade" on this system is much less than on other types of antennas which have fixed polarity. This was tested by switching rapidly from horizontal to vertical polarization as compared to the "V" configuration.

The possibilities of applying this principle to multi-element beams is obvious and plans in the near future are to construct a three-element parasitic beam with the angled elements, to gather full data. Again the test will be conducted on scaled down models at UHF frequencies before moving to full size 14 megacycle elements.

In closing gentlemen, try one, and you too can have the largest pair of "Wabbit Ears" in your area. 73

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Nov. 13—Trip report: Impressions of an American Engineer-Visitor to the U.S.S.R.

Nov. 20—Electromagnetic Compatibility.

Nov. 27—Applications of Ultrasonics.

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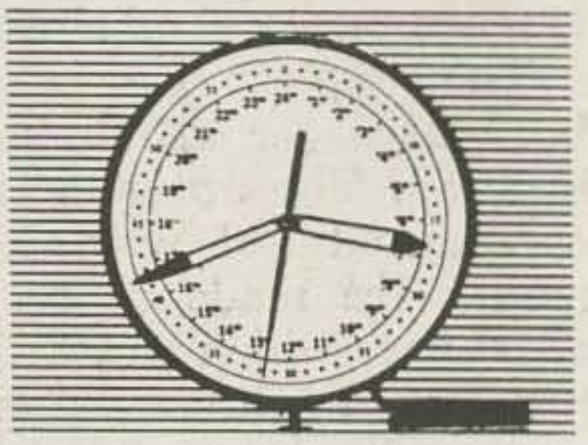

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(10 METER CONVERTER from page 11)

e transistors provisions can be made for ounting small transistor sockets. ELCO 3301 ckets are ideal transistor sockets for circuit ards. The sockets make it easy for experi- enting with various transistors.

The coils should be wound and ready for ounting next. Coil data is found under Cir- it Drawing, Fig. 1. L1, L2 and L3 are wound 3/8" diameter ceramic coil forms which are on slug tuned. L4 is a vari-loopstick with e secondary scramble wound over the pri- ary. The coil taps are made by twisting a " of coil wire at the appropriate place for e tap. The twist is then stripped by holding e twist in a match flame and finishing with e steel wool or emery paper. After stripping e twist can then be solder tinned.

The coils and transistor sockets can now be ounted on the circuit board. Following Fig. 3 e resistors and capacitors may be mounted d soldered in their proper place. Care should used when soldering on the circuit board. nly hold the heated iron on long enough to ake a good soldering connection and use only good rosin core solder. Capacitors C7, C8 and are soldered directly across coils L1, L2 d L3. After all components have been ounted and soldered check the circuit board rough with Circuit Drawing Fig. 1 to elimi- te any possible mistakes. The X-sistor Con- rter is now completed and ready for final justments. The converter may be covered th any type of a box. The author used a x 4" x 2" Bud aluminum chassis with J1 d J2 fastened closest to the input and out- t.

Adjustment and Operation

Before operating the converter use a grid-dip eter to tune the local oscillator to approxi- ately 28 mc. This check is made with the nverter switch off and by adjusting L3 for e dip. Adjust L1 and L2 for approximately mc. Additional accuracy may be obtained checking the oscillator if another receiver ned to 28 mc is used. If this method is used, rn the converter switch on and adjust L3 til a beat note is heard on the receiver.

It is necessary to use a length of shielded le between the converter and the auto re- ver. After making this connection and turn- the receiver and converter on you should rt to hear signals. Final peaking is best ne by tuning in a signal and adjusting L1 d L2 for greatest speaker output. When ng a 28 mc crystal, signals at 28.5 mc will pear at 500 kc and 29.5 mc signals appear at 00 kc on the broadcast band dial. After the al adjustments are made the converter may mounted at any convenient place on the to dash and you will enjoy many hours of tening on the 10 meter amateur band. 73

GET THE MOST OUT OF YOUR HAM STATION

SHORTWAVE PROPAGATION *by Stanley Leinwoll (Radio Frequency & Propagation Mgr.—Radio Free Europe)*. Of special interest to those concerned with radiocommunications. This review in QST (May 1960) sums up the book's vital interest to all amateurs:

"... written at just the right level for the amateur interested in ionospheric propagation ..... There is ... background material—necessary for an understanding of the subject—on the ionosphere, on radio waves, on sunspots and the sunspot cycle, all treated in language that is easy to follow. The section on ionosphere measurements introduces the ideas that are important to the detailed understanding of ionospheric propagation, leading to the use of ionospheric charts and predictions for the determination of maximum usable frequencies and optimum working frequencies. The calculation procedure for distances shorter than the maximum one-hop, generally neglected in amateur literature, is also included.

Of special interest to QST readers are chapters on amateur contributions to knowledge of wave propagation and a forecast—advanced with admitted caution!—of probable amateur-band conditions during the coming sunspot cycle. Throughout the book the reader is introduced to various interesting aspects of propagation: one-way skip, for example, scatter, meteors, auroral effects — all the things that hams continually encounter in everyday operation. It would be hard to find a question about propagation in the 3-30 Mc. region — at least the type of question that an amateur would ask—that isn't covered somewhere in this book, even if only (of necessity) by the statement that the answer hasn't yet been discovered." #231, **$3.90.**

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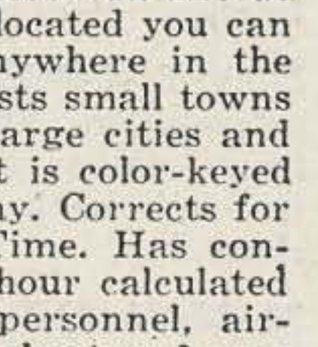

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Next Month

We've got a lot more construction articles lined up for December. Probably the one that will have the most fellows rushing to the workshop is the **RF Sniffer,** which you can put together very easily and use a lot. The VHF boys will get the build-its when they see the job ZL1AAX did on a **Low Noise Two Meter Converter.** This is the most modern and up to date design yet. K5JKX presents one of the first articles we've seen on **How To Transistorize** your tube circuits. And while we're transistorizing, we have a brand new circuit . . . the first time anywhere . . . a **220 mc Transistorized Crystal Controlled Converter.** Then we have the world's **Simplest Phone Patch,** an interesting **Station Control Unit,** a **Multivibrator VOX** circuit, a **Dynamic Demonstrator** for SSB, a feature article on squelch circuits, and a raft of other articles.

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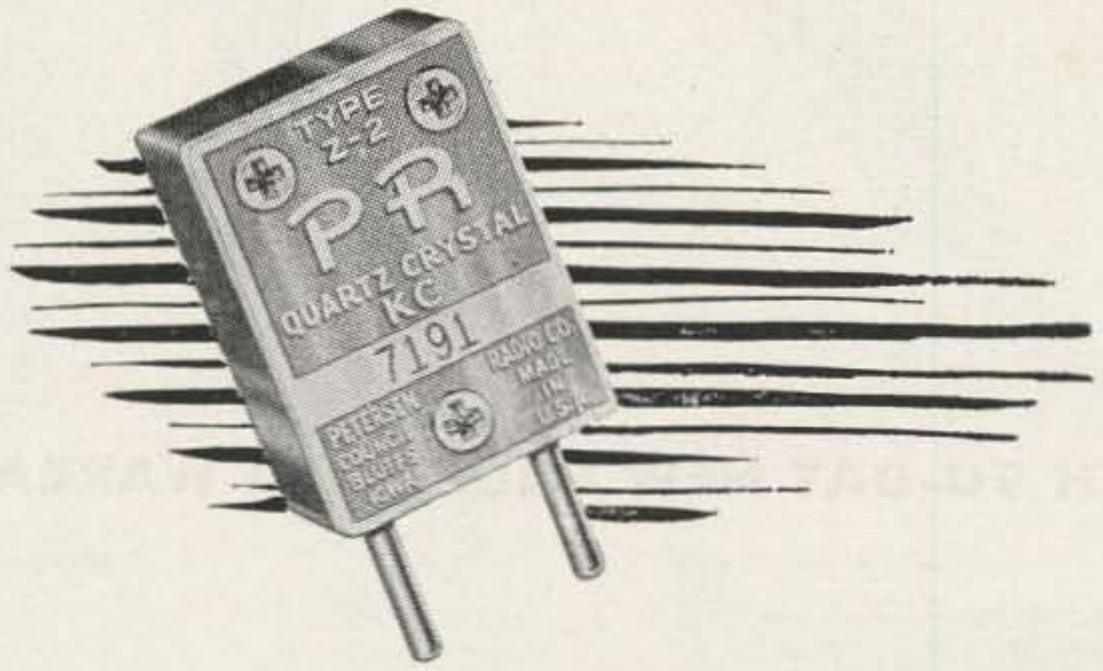

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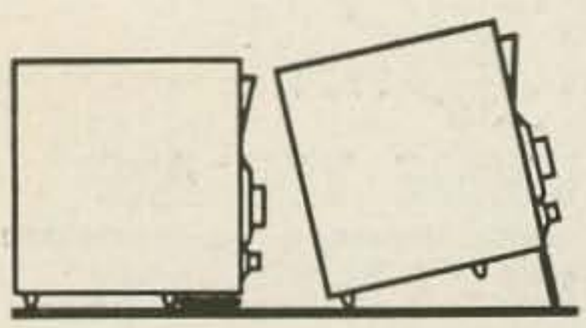

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